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A New Shaper.

We present on this page an illustration of a shaper recently brought out by Gould & Eberhardt, of Newark, N. J.

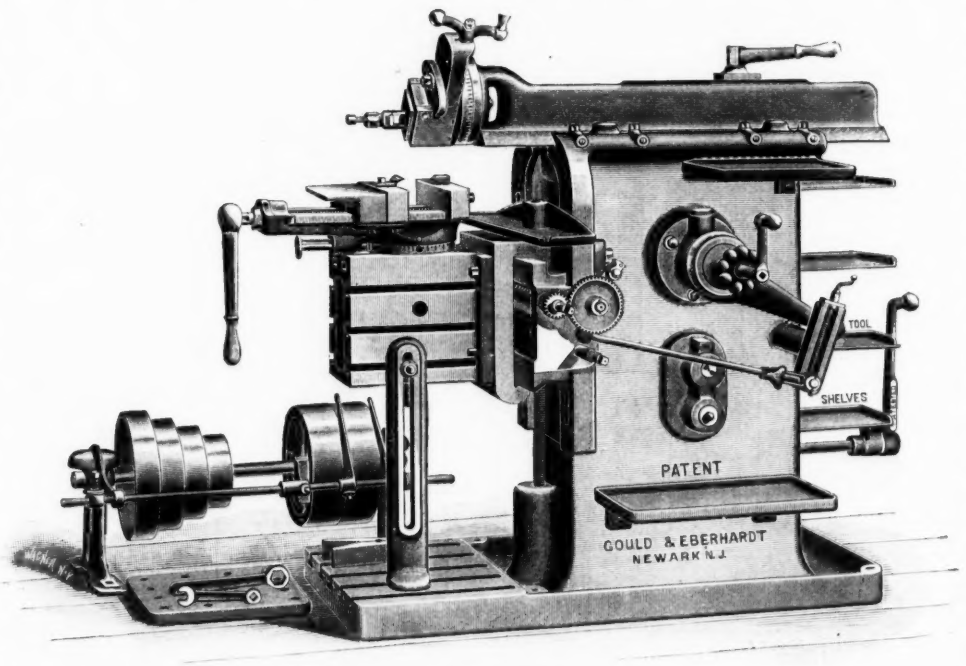
It will be noticed that this shaper has an extension base which serves the double purpose of giving it increasing bearing and steadiness upon the floor, and also provides a means of extra support when taking very heavy cuts, and special provision is made for holding work in a variety of ways according to circumstances. It can be fastened to either of three sides of the box-shaped platen, or this platen can be removed and the work fastened direct to the saddle. The vise has a pair of special jaws for taper work and adjustable centers, which can be used for fluting taps, reamers and other tools in cases where a milling machine is not available. The vise swivels to any angle upon a graduated base.

An improved crank motion is used which enables the stroke to be readily and accurately set at any desired length, graduations showing just what the stroke is. This motion also gives an unusually quick return stroke, by which the makers state that on short work double the number of strokes are made that can be obtained with any other shaper.

The feed motion is arranged so that the feed can be changed and set at any desired number of notches by a crank motion which can be handled when the machine is in motion and indicates the amount of feed.

There is also, as will be seen, a liberal provision of shelves, which are convenient for holding tools, etc., and tend to economy of time.

The extra plate seen upon the floor is for holding work not otherwise conveniently held. These shapers are made in nine sizes.



A NEW SHAPER.

The Greiner & Erpf Cupola.

BY W. F. DURFEE.

The cupola which you illustrate in your paper of September 27th is a construction of which there are over 400 examples in use in the more important metallurgical establishments of Europe; such as Balkow, Vaughn & Co., Limited, Middlesboro-on-Tees; the Dowlais Iron & Steel Co., Dowlais, South Wales; Henry Bessemer & Co., Limited, Sheffield; Société John Cockerill, Seraing, Belgium; Schneider & Cie., Creuzot, France; Fried Krupp Essen, Germany; Rheinische Stuhlwerke, Rhurort, Germany, whose names are sufficient to entitle any invention which they may have in daily use to a favorable consideration from parties requiring such apparatus.

As the result of a careful study of the various forms of cupola in use, I several years since designed and constructed the first Greiner & Erpf cupola erected in America, and therefore I am disposed to think that I possess some qualifications for explaining its operation, and as you seem to regard the performance of the example described by Mr. Bollinckx as "a mystery," some detailed description of the peculiarities of this type of cupola may not be without interest.

In the common form of cupola, from whose throat a vast volume of flame escapes during a "heat," there is more fuel wasted than is actually necessary to do the work of melting; for the heat developed by the combustion of the escaping gases at the top of the cupola contributes in no way thereto, but usually represents a waste of heat units more than sufficient for that purpose. This was long evident to intelligent practical men who had carefully observed and studied the behavior of cupolas as ordinarily built, but it was reserved for Greiner & Erpf to devise a construction which realizes in practice as perfectly as is possible the theoretical considerations involved in the combustion of fuel and the melting of iron in cupolas, and they have succeeded in utilizing in the type of cupola you have illustrated nearly all the heat formerly wasted at the top of the cupola, by burning the gases formerly consumed there, in the interior of "the charge," the results being a total absence of flame at the cupola's top, more rapid melting, and a saving of fuel ranging from 15 to 50 per cent.

In order to make clear the peculiar operation of the Greiner & Erpf cupola, it is advisable to first describe the chemical changes which take place in the burning of fuel in an ordinary cupola. As the blast of air enters such a cupola by the "tuyeres" it distributes itself through the lower part of "the charge," and immediately each atom of carbon in the fuel with which it first comes in contact, combines with two atoms of the oxygen in the blast, forming carbonic acid (I believe carbonic binoxide, or carbonic deutoxide, are more modern terms, but both professors and practicers of chemistry when I was under tuition were contented, and even happy, with the less ponderous designation), which is an incombustible gas, usually indicated by the chemical symbol $C\ O_2$.

As this incombustible white hot gas rises through the incandescent fuel on its way to the top of the cupola, it absorbs another atom of carbon and becomes $C_2\ O_2$, or $C\ O + C\ O$ (also written $2\ C\ O$), or in ordinary language, two volumes of a combustible gas called carbonic oxide, each of which will at the high temperature existing greedily combine with another atom of oxygen whenever it can find it, developing a large amount of heat by so doing, and forming $C\ O_2 + C\ O_2$ (also written $2\ C\ O_2$), or two volumes of carbonic acid—twice the volume of the same incombustible gas as was first formed in the lower part of "the charge"—*but*, as there is no free oxygen in an ordinary cupola much above the "tuyeres," the two volumes of carbonic oxide ($2\ C\ O$) formed as above stated cannot find any oxygen to combine with until they have passed entirely through "the charge" and reached the atmosphere at the top of the cupola, when immediately the combination takes place and the two volumes of carbonic oxide ($2\ C\ O$) become two volumes of carbonic acid ($2\ C\ O_2$), with the development of great heat where it is not only utterly useless for melting the iron of "the charge," but oftentimes a source of great danger to surrounding property.

The great importance of the conversion of all the carbon of the fuel into carbonic acid ($C\ O_2$) within the charge in immediate contact with the iron to be melted is evident from the following facts, viz., the complete combustion (producing carbonic acid, or $C\ O_2$) of one pound of carbon results in the production of 3.66 pounds of carbonic acid ($C\ O_2$), and the development of 14,544 units of heat, while if the carbon is only burned to carbonic oxide ($C\ O_1$) there will be but 2.33 pounds of this gas, and a development of but 4,452 units of heat, hence the heat units resulting from the formation of carbonic acid ($C\ O_2$) by the combustion of carbonic oxide ($C\ O$) are equal to $14,544 - 4,452 = 10,092$ heat units, or 69.39 per cent. of the total calorific value of the pound of carbon, hence of every pound of carbon burned in the form of carbonic oxide ($C\ O$) at the top of a cupola 69.39 per cent. is absolute and unadulterated waste.

Now, let us see how much carbon is theoretically required to melt a pound of cast-iron if the heat developed is all utilized for that purpose.

Gray cast iron melts at 2,200° Fahrenheit, and if we suppose its temperature to be 60° F. when it is put into the cupola, we shall have to raise its temperature $2,200° - 60° = 2,140°$ F., as the specific heat of cast-iron (*i. e.*, the number of heat units required to raise the temperature of one pound of iron one degree Fahrenheit) is 0.12983, we have $2,140° \times 0.12983 = 277.83$ heat units, and as the total heat units developed by the perfect combustion of one pound of carbon is 14,544, by dividing this by 277.83 we will have the number of pounds of iron that could be melted by one pound of carbon, or 52 34 pounds, but as coke contains but 85 per cent. of carbon, the amount of iron that could be melted per pound of coke, if all of the heat were utilized, would be $52.34 \times 0.85 = 43.49$ pounds. This, of course, is a theoretical condition which can never be realized in practice, and it is undoubtedly true that the older forms of cupola do not melt more than one-seventh of this, and very few indeed of the more modern forms (other than the Greiner & Erpf) more than one-quarter. The cupola you have illustrated shows an efficiency of about 50 per cent., which is very good indeed, and considering the amount of heat that must be carried off by the nitrogen of the blast supplied to the cupola, and the radiation of heat from its walls, I do not think it probable that this result will be excelled.

The cause of the remarkable efficiency of the type of cupola you illustrate is the fact of introducing streams of air by means of the small auxiliary tuyeres to the body of the charge to consume therein any carbonic oxide ($C\ O$) that may be formed, and prevent it from escaping from the charge unconsumed. From the top of such a cupola there is no flame seen, and I was so confident of the behavior of the cupola that I constructed on this plan that I projected its top but 18 inches through the roof of the cupola house, and during the year it was run under my supervision there was no flame ever seen escaping from it. There are several of these cupolas in operation in the State of Pennsylvania, and some in the West, but in the Eastern States I know of but two attempts to run them, and these were abandoned after two or three heats, their owners claiming that there was no improvement over their previous practice, and not caring to persevere in the use of an apparatus that would have saved them at least 15 per cent. of their fuel. One of the greatest, if not the greatest obstacle to the introduction of any improvement, is to get its users to abandon utterly their old methods. Many a failure has been caused by attempting to combine ancient ideas and practices with improvements that were especially designed to succeed by ignoring them. It is said that soon after General Grant took command of the Army of the Potomac, and a forward movement was about to be commenced, one of his officers suggested the advisability of making certain provisions for a possible retreat. "This army has done retreating," was the stern

reply of the General. As in war, so in all things, success comes by pressing forward, and never by standing still or moving backward.

Spacing Holes.—II.

By Easy Way.

The last operation described in the first paper on this subject is elementary, but it is just exactly what is to be done to the bicycle chain link, in just about the same way, and done by a good machinist, too. That is, the good machinist does it all in his mind, and then so impresses his own thoughts on certain elements of metal and leather that these seemingly dead and unintelligent things will furnish brains and care and close work sufficient to control the actions of a very unintelligent "chunker," who barely knows enough to move a lever and put a piece in the machine and take it out again. We will keep the face plate and the lathe spindle to make the bicycle chain links with, but they will be very much changed. The face plate will become a round indexed table, and the spindle we will multiply by the number of operations to be performed on the link to make one hole in it. The first hole in the links can be jig drilled and hand reamed, or reamed in an upright lathe, any way at all. It is not the first hole that gives any trouble, nor is it the making of the hole that wants thought for the second hole in the link; it is the location of the second hole in relation to the first one.

There are four operations, drill, bore, rebore, and ream, hence four spindles; if all these spindles work at once then all four of the operations may be performed in the time of the longest of the four; if there are four spindles then there must be at least four stations at which the face plate is to stop, but here is another condition. These four spindles are to work as much of the time as possible; also the unintelligent machine tender must not be allowed, in his menial part of feeding the intelligent machine, to delay its action. Both the machine and the feeder should work all of the time. Of course, the machine tender has to put a link into the machine as often as one comes out, which is, or should be, if the time of the longest operation is 20 seconds, including the transit of the table from one station to the next, 3 links per minute; hence, if there is the space of one spindle left vacant in the machine framing, and hence one station of the flat turret always uncovered by the spindles, the machine tender has all the absolute time for feeding which he can have. But he must use this time, which has been assumed at 20 seconds, in precisely the machine time; he has no margin; now, if the turret space uncovered by the spindles be increased to, say, 3 or 4 stations, though the machine tender has yet to put in a fresh link three times a minute, he does not have to do so once in every 20 seconds; and the tender also has more space in which to operate, and the whole work of the machine is made more open to observation. Therefore, say there are 4 operative stations of the turret, and 4 vacant stations, making 8 stations in all, which, remembering Fig. 3, gives a "face plate" (to keep the same name), as shown in Fig. 4. But by this time the machine shop is left behind, and the "automatic tool" department is reached; the work is no longer "built," it is "manufactured" now, and the "face plate" has become a "flat turret."

In Fig. 4 the flat turret is shown as having eight index notches, and an index latch, the latch pivoted to a latch arm which forms an extension of the hub through which the turret shaft passes. In a circle concentric with the shaft axis are eight pins P which fit the already bored eyes of the links, and sixteen small position pins, which locate the unfinished ends of the links marked p. There is supposed to be a drill spindle directly over the partly drilled hole in the link eye marked 1, and a boring spindle over that marked 2, a reboring spindle over that marked 3, and a reaming spindle at 4, all in an arc of a circle concentric with the vertical turret shaft and all exactly one link center to center distance apart, and this circle must be exactly the same diameter as the circle which passes through the center of the eight pins P. If it is difficult to drill two holes at a fixed distance apart, how are all of these pin and spindle holes to be exactly located and spaced? It is evident that any variation in the location of the spindles, the link eye pins, or the eight index notches in the edge of the turret will make bad work. How good a workman must the machinist be who makes a tool organized on this plan to drill links spaced alike from center to center?

Suppose the frame of the machine to be made as in Fig. 5, which shows a plan and elevation. The two hubs A, A^1, are in line with each other; A takes the turret shaft, and A^1 takes the spindle driving shaft with which we have to deal. The four long hubs B, B^1, B^2, B^3, take the drill spindle, the boring, the reboring and the reaming spindles. Returning to Fig. 4, it is evident that to use the flat turret with

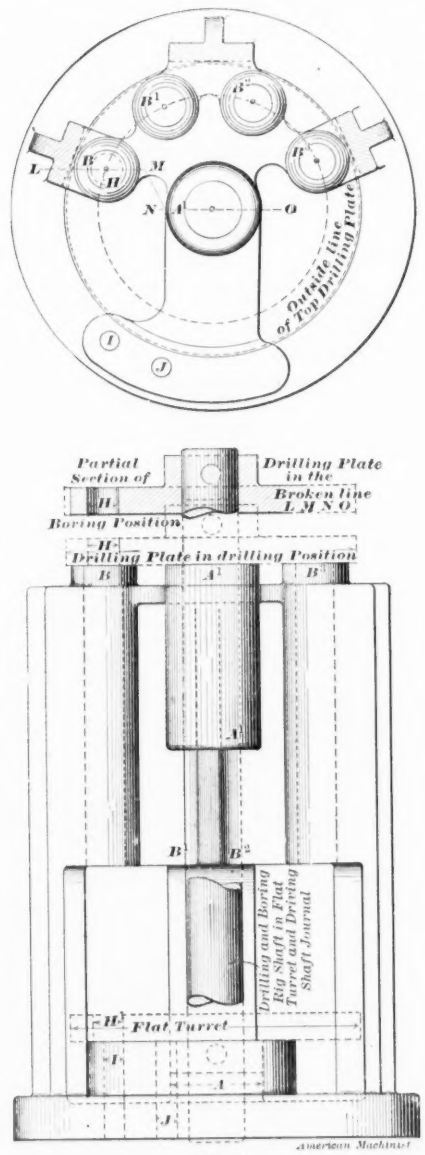

Outside line of Top Drilling Plate
Partial Section of
Drilling Plate in the
Broken line L M N O
Boring Position
Drilling Plate in drilling Position
Drilling and Boring Big Shaft in Flat Turret and Driving Shaft Journal
Flat Turret
American Machinist

Fig. 5

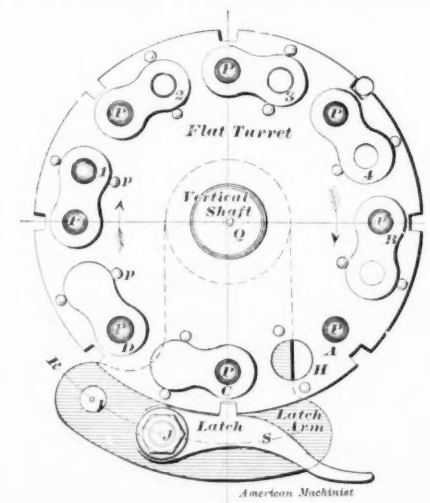


Fig. 4

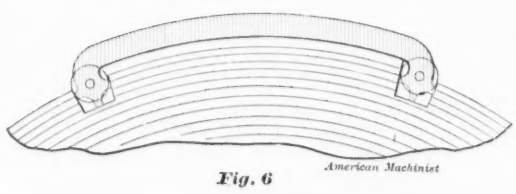


Fig. 6

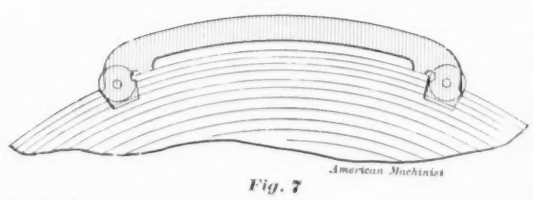


Fig. 7

Spacing Holes.

finishing the sleeves separately, with feet or flanges at the lower end, and bolting and pinning them in place after they are all located so that tits on spindles filling the holes in B just exactly "match up" with four holes in the flat turret in position in the machine; and not with one sequence or group of four holes in the 8-hole circle in the flat turret, but with any one of the eight sequences of four holes each in that circle of pins P.

Clearly the first step is to make the flat turret itself, and cut the index notches. However the notches are cut, whether on an index machine at home or abroad, it is needful to test them for accuracy, to compare the spaces from center to center of the notches. A proof gauge may be filed to fit close, of the shape shown in Fig. 6, or as in Fig. 7; in Fig. 6 the gauge is fitted to stop at each end on the bottom of the index notch, which makes the index notch alone govern the gauge position in use; in Fig. 7 the gauge stops on two narrow feet on the circumference of the flat turret or index plate, and does not touch the bottom of the index notch at all; either is a delicate and uncertain job; difficult to fit in the first place and questionable in use.

Make in the lathe two shouldered collars as in Fig. 8, of such diameter that the larger circle will exactly touch on the two sides and bottom of an index notch, as in Fig. 9, and tin the surface x y, Fig. 8, ready for soft soldering. Take a piece of suitable flat stock and tin one side; put the tinned sides of the collars and flat bar together, put the collars in two adjacent notches of the flat turret, having first screwed one of the collars to the bar. Scribe the hole in the other collar on the bar while both collars are in index notches, and touching at three points in each collar as a b c, Fig. 9; drill and tap and put in the other screw, making the whole job as in Fig. 10. Then heat each end enough to make the solder stick the collars to the bar, so that they will not move; by this method the holes in the washers can be larger than the screws, so that the washers can be adjusted to the index notches accurately, and the shoulders on the under side of the washers keep the gauge edges up clear of the dirt corner and also admit light to the under side of washer when the gauge is in use. This gives a gauge with which the index notches can be tested, and which will show the spacing to be faulty if it is not absolutely perfect. It is not safe to trust any index cutting without testing. All drilled index plates are faulty, and it is but rarely that any job of index cutting, no matter where it is done, is beyond criticism when it comes out of the machine. In point of fact with all our boasted advance in mechanic arts we have found but one straight line, and that is the ideal axis of a revolving body, and but one sure outline, a circle made with that ideal line as an axis. When we find a way to move that ideal straight line we can make flat surfaces with machines, and sometime we may be able to divide a circle with certainty. The best we can do now in the way of dividing the circle is, perhaps, as shown in Fig. 11. Make, in this present case, eight washers, case hardened, and ground to the same diameter outside by putting all together on an arbor in the grinding machine. Turn off the outside of the hub on the underside of the flat turret until the eight washers will just touch each other and the hub, all as shown in Fig. 11, and screw the washers in place. It is obvious that an index can be made this way which will only vary as the diameters of the washers vary from each other. Washers of this sort can be put on an arbor and turned one after the other in an engine or slide rest lathe without moving the tool, with almost perfect uniformity in soft steel, so that it is easy to do very good original dividing by this method with the lathe only. The Thorne type-setting machine has its cylinders—perhaps 14 or 15 inches diameter—cut with an index of this kind, so perfectly that no difference in the cuts can be found when the cylinders are mounted end to end and turned round on each other, and the belief is held in that shop that no other way of making an index plate is so certain as this method which makes every index an original.

Suppose, however, that by some method the notches in Fig. 4 have been perfectly spaced, and that the vertical holes for the flat turret shaft and the driving spindle have been made in the hubs A, A 1, Fig. 5, and that the latch, Fig. 4, is in place. Make a blank disk with a hub, all the same as the flat turret, and put it on the turret shaft face to face with the turret, turret hub down, blank disk hub up, and drill the hole H, Fig. 4, through both plates; then with the turret and the blank on a long shaft in position, as shown in dotted lines in Fig. 5, drill the holes in B, B 1, B 2, B 3, through bushes in H, H^1, indexing the shaft and the two plates from one hole to the other with the latch, Fig. 4. Go back, put a boring bar in the holes H in the plates, and bore the spindle holes in the hubs B to perfect truth. This will locate the four spindles for drilling, boring, reboring and reaming the second hole in the bicycle chain links perfectly, and by use of these spindles the holes for the pins P, Fig. 4, may be made so as to bring the links all one length center to center. To drill the holes for P, the latch, Fig. 4, turns on J, and J has its center in the arc R S, struck from the center Q, Fig. 4. Make the hole I same diameter as J in the arc R S, and put J in I, and then index the flat turret around, drilling, boring and reboring and reaming the holes for the pins P in the flat turret as it goes round with the same tools that are to be used for the link eye.

Put the pins P where they belong, and move the latch stud back to the J position. Now the bicycle chain links may be spotted by their one finished hole on the pins J, and latching the flat turret around will bring their blank ends successively in position under the four tool spindles B, B 1, B 2, B 3, in correct position for the second hole; the only uncertainty now lies in the center to center distance between the holes, which will be exactly that called for by the distance between I and J. As I and J are farther away from the center Q, Fig. 4, this center to center distance between I and J is a matter of calculation, and may be determined mathematically or graphically; in either case the location of I with regard to J may have involved an error which will make the holes in the links uniformly too close

together or too far apart. Should such be the case, the hole *J* may be enlarged to take an eccentric bushing, and this bushing fitted to take the pin *J*, on which the index latch is hung, and by turning the eccentric bushing and refitting the latch in the index notches if needful, the precise distance between the holes may be secured ; or, if preferred, and which is probably better, the hole *J* may be scraped the needful way, and a new latch pin fitted to it at each scraping, until the link length comes right.

I have thus sketched briefly, but I trust intelligibly, to the American tool maker at least, what I believe to be the best method of construction for index machines having more than one spindle, and shown how the job can be done perfectly with no more tools than a common engine lathe and a vise. It is a job which, as ordinarily performed, taxes the resources of the best establishments and requires extreme care, skill and patience on the part of the workman. It will be observed that the method of performing the work is precisely the same as shown in Fig. 3. Simply a face plate job.

In the sketches no attention has been paid to proportion. The links to be operated on in Fig. 4 are very much too large for the flat turret they are placed on. The aim is to show the method, not the details. A striking example of the value of the use of an independent boring bar for each spindle seat of a multi spindle machine was shown in a driller for finishing the frame of the Home sewing machine, built by Colonel Woodruff, contractor in the Pratt & Whitney shops. This machine had, I think, 13 spindles, and was driven by an 8 or 9 inch pulley. So perfect was the alignment that by pushing on the face of this small driving pulley with the tip of *one finger only*, the entire running work of the machine would revolve readily. There were a large number of gears and some transfer shafts, besides the 13 closely fitted drilling spindles. This incredibly easy drive was attributed by Colonel Woodruff entirely to the perfect journal alignment secured by boring and reboring every bearing with an independent boring bar located in its own journals. No more convincing proof of the value of this method could be given than was afforded by that machine.

Relay Pumps—Long Gear Teeth.

By W. H. Booth.

The oil pipe line has taught engineers that a liquid may be transmitted many miles through pipes by the establishment of relay pumping stations at suitable distances apart. I understand that these relay pumps draw from the oil main and deliver again to it; not that tanks are provided into which the pipe line discharges, and from which the relay pump draws. Yet in ordinary practice we do not by any means find this principle carried out. Of late years the question of a pump receiving its supply under pressure has been raised, and the folly exposed of wasting the energy of a pressure supply by running it into a suction tank as though a pump could not perfectly well work in a pressure main. But the principle might be further extended. For example, a steam engine condenser is now usually made to lift its own injection where this is within, say, about 20 feet of the inlet. But at greater depths to which a condenser is apt to miss its water, or where the level is out of reach altogether, a pump is put in to lift the water to the level of the condenser. Now, it seems to me that it is quite unnecessary to lift the water to an open cistern at the condenser level from which the injection is drawn as usual into the condenser. This is a waste of power. I would have the pump placed low enough to lift the water, but would connect its delivery to the condenser direct by a closed pipe, and it should not be a difficult matter to do this. Such an arrangement would utilize to the utmost the lifting capacity of the vacuum, and only leave to the pump the duty of adding the difference of work necessary.

We may see direct acting pumps set to force water to a tank, say, 50 feet high, and find that they are drawing from a tank below floor that is fed from a pond some 20 feet above. The real duty necessary is thus only 30 feet, and the 20 feet extra is quite

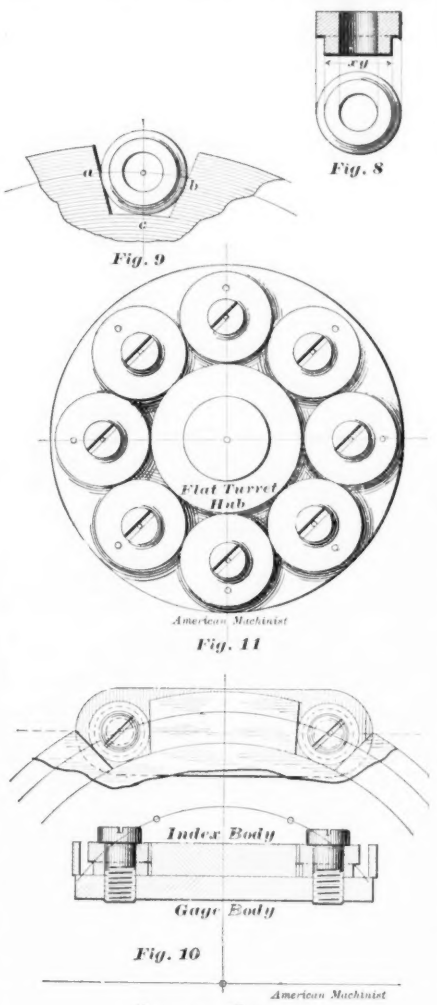


Fig. 8 Fig. 9 Fig. 11 Fig. 10

Spacing Holes.

unnecessary and wasteful. Think of the enormous aggregate waste of fuel during the past century that has arisen from this mistaken idea of a pump being required to suck its supply. Men have been deceived by a name.

The first pumps were made to suck water from points beneath them. Every pump needed a suction, and it had got to have one too long after there was no need of it.

We are all too much tied by precedent. Only to day I had to inspect an American machine; I found it had gear teeth as long as the longest gear teeth made on this side, where, in spite of ample proof to the contrary, there are few who do not persist in the old rules and make long teeth. My own practice for some time past has been to make teeth one half their pitch in length, but all my recent practice has been with a pitch of 1½ inches, for which the tooth length is thus ¾ inch. Such teeth look strong—they do not look as if they would be knocked off by a tap on one corner, and they have ample surface. Short teeth may be made much nearer their correct form than is wise with long teeth. They are in less danger of damage in the sand and less liable from any uneven contraction to be canted over seriously, and they are quiet in working. The length of ¾ inch looks ample even for teeth of much greater pitch than 1½, and I shall not make any future tooth so much as half pitch long, especially when the pitch is over 1½ inches, but I have no rule to guide me. Probably, for ordinary pitches of from 1 to 4 inches a fair rule for length would be $\frac{\text{Pitch}}{4} + \frac{1}{4}$ inch. This would give ¾ inch to a 2-inch pitch.

I can speak from experience when I say that short teeth give one a much safer feeling as to the life of one's work. There is an easy feeling no one can have who is responsible for a long tooth. One advocate of short teeth makes them with a semi circular top and makes the bottoms of the spaces also semi-circular.

The two semi circles are joined by a short bit of true tooth form. Thus the teeth are really very short, indeed, but have a long appearance as a concession to prejudice, but with a very strong root form. Still this seems false practice.

Why put in an ugly form and a lot of useless tooth projection to solve an idea only. Further, big lumps of teeth add nothing to the strength of a rim—nothing to its resistance of centrifugal bursting stress, but they do add to the stress itself. In fact, long teeth have in the past given a bad name to large toothed gears and helped on belts and ropes which have not nearly so great a mechanical efficiency as gears.

As regards shortness of tooth, I believe my own practice has by no means reached finality.

Ship Timber Jig Saw—Accurate Hole Locating.

By James F. Hobart.

The engraving and description of a ship timber band saw on page 5 of the August 23d issue, brings to mind a jig saw for similar work, which is the only one of its like that I have ever seen. The saw in question is in use in Brooklyn, N. Y., out upon the extreme end of the island below Erie Basin. The saw is of the kind which is stiff enough to stand up to the work without being strained. The blade is about two inches wide (exclusive of the teeth) and about $\frac{7}{32}$ inch thick and runs about 350 strokes per minute.

A pair of "line" fluted feed rolls is provided, one in front of the other, in the rear of the saw. These rolls are operated by worm and gear mechanism, which is controlled by the foot, for starting and stopping the timber in its progress against the saw. The saw, which can be inclined more than 45 degrees either to the right or to the left, is mounted in a circular frame about 8 feet in diameter as shown by Fig. 1. This frame is built of wood, two thicknesses of 2 inch plank segments being glued and nailed up to form the circle.

Two inward projections *a* and *b* carry the saw connections and guides. The pressure roll *c* is also attached to *b*, and is controlled by a screw and gearing which is actuated by a hand wheel (not shown) located at *d*.

Another hand wheel, at about the same place, works a pinion and circular rack, which sets the circle to any desired angle indicated by the index *e* and graduated limb *f*. The top and bottom guides of the saw are only indicated in the engravings. Neither is the rigging of pressure roll *c*, shown in either Figs. 1 or 2. The belt indicated by the dotted line drives a pulley

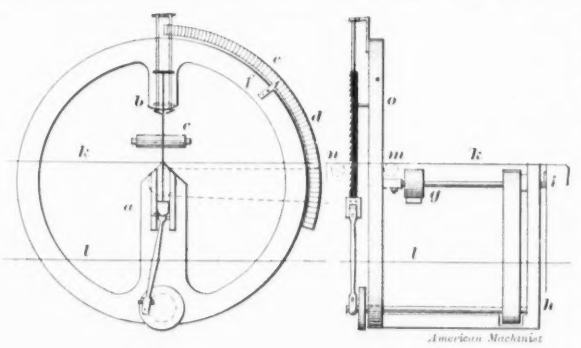


Fig. 1 Fig. 2

Ship Timber Jig Saw.

and shaft located in the exact center of the circle. This is shown more fully in Fig. 2, *g* being the pulley mentioned. The arrangement of shafting and pulleys is clearly shown by the engraving.

The frame *h* is built into the circle and swings with it. This part of the tool is pivoted at *i*. The table *k*, and floor line *l*, are located about as shown, the former being built just high enough to free the pulleys and belts on the shaft *g*. Two live feed rolls, already mentioned, are located at *m* and *n*, Fig. 2, and a small blower (not shown) is fastened to the circle at *o*, Fig 2, just back of the drop *b*, Fig. 1. The blower is a piston affair about five inches in diameter, and is driven by a crank and pulley belted up from the lower shaft.

Timber 15 inches thick can be cut by this machine, and the table or bench is horizontally stationary at all times. This enables the sawyer to make as many bevels on the same timber as he chooses. The press roll *c* has a positive movement, so that quite a heavy timber may be held in position after one end thereof had been caught under the press roll. The machine being so simple, and built mostly of wood, is a good *thing to copy* for "home made" work.

The method described for accurately locating holes in jigs and dies, by Oberlin Smith, in August 30th issue, brings to mind a method which I have frequently employed for accurately spacing work in wood, tin, iron and brass. For this purpose I have used with first class results the spaces and quads of an ordinary font of printers' type. The size known as "pica" is, perhaps, the handiest for this purpose, and "em" quads are made exactly square and about three quarters of an inch long.

A "pica" is pretty close to one-sixth of an inch. The micrometer says it is .168 inch on a specimen recently measured. The sizes of "pica" by different makers of type may vary a little, but not much, especially if the type be modern, and made on the so-called "point" system. As the method, as far as I have used it, has been comparative rather than absolute, I have had no occasion to look up that part of the matter.

Quads are made in one, two, and three "ems," that is, their width is one, two or three times the thickness, or ⅙, ⅓ and ½ inch. The spaces run down from "twos" to "sixteens," or from $\frac{1}{12}$ to $\frac{1}{96}$ inch, the principal sizes being ½, ¼, ⅓, ⅙ and ⅛ pica, corresponding to $\frac{1}{12}$, $\frac{1}{18}$, $\frac{1}{24}$, $\frac{1}{36}$ and $\frac{1}{48}$ inch, the very thinnest spaces, twelfths and sixteenths, are not much used, being too thin and fragile to stand usage.

For 20 or 25 cents a pound of assorted quads and spaces may be bought from any dealer in printers' material, and among the several hundred pieces of accurate sized compressed metal thus secured, will be found means for doing a good deal of accurate spacing and lineal dividing. The metal being soft (lead, antimony and arsenic) the spaces and quads must be handled tenderly. Any dent, bruise or bend destroys the usefulness of that particular quad for measuring purposes, and it must be thrown away at once.

In spacing a long row of holes to be drilled, a steel bushing was made for a guide to the drill, then the work was laid on a straight surface and the bushing, set fast in a carrier, was clamped rigidly to the straight surface which was so arranged that the work to be drilled would slide between the straight surface and the bushing carrier. A lot of the spaces and quads were then packed in between the end of the work and a lug projecting from the straight surface. After drilling a hole the spaces were adjusted so as to bring the proper place for another hole beneath the bushing. In drilling a lot of holes ⅛ inch apart it was only necessary to remove an "em quad" every time a hole was drilled, slide the work along to a new bearing and drill again.

On the wood saw bench I have made many a set of parallel grooves by adjusting quads for a distance bearing of the work against the fence. Take good care of the quads; don't drop them, and when jammed ever so little throw them away and buy new ones.

Figuring Drawings.

By Oberlin Smith.

In the term "figuring," as embodied in the title, I include not only the actual figures expressing the dimensions of a scale-drawing or sketch, but the reference-letters, figures or other symbols, the dimension lines which are projected from various parts to

give proper room for dimension-figures, the pointers (or arrow heads, as they are sometimes termed), which point out the line of the drawing or dimension-line where the measurement expressed by the dimension-figure starts or stops, the pointer lines which show the location of the dimensions, together with all other marks not belonging to the drawing itself. Preferably, of course, all these auxiliary characters and lines should be of a different color from the drawing proper, red ink being much the best material to use when the drawing is black or blue, or of any other dark color. This is not only because red is the conventional color generally used for any "false" marks, so to speak, upon both written documents and drawings, but because it is inherently good—being dark enough to be legible, and yet being in very distinct contrast to lines of nearly all other colors. When it can be used, the remarks following later in this article about cumbering a drawing with too many false lines are not as pertinent as when these lines must be of the same color as the drawing itself, which is unfortunately the case with nearly all printed work in books, and with all photographed work, such as blue-prints, black-prints, etc. As these last named classes of drawings are (in the present state of the art) greatly in the majority, the question of so figuring them as to get the best possible result is of great importance, but is one to which sufficient attention is not usually paid.

Some of the principal attributes of a good drawing are: 1st, *accuracy*, that it may not tell any lies, and thereby absolutely reverse the purpose of its existence; 2d, *definiteness*, that there may be no possible chance of one observer being in doubt, or two observers having different opinions in regard to the meaning expressed; 3d, *completeness*, that there may be no necessary information omitted; 4th, *simplicity*, not only that time and trouble may be saved in making the drawing, but more especially that it may be so legible as to be read both easily and quickly, and may express the general form portrayed to the eye of the observer at the first glance; 5th, *neatness*, a quality that does not need explanation nor endorsement.

The groups of figures and the sketches given below I have persuaded the editor to print in *fac simile* from my manuscript, as I can thus better show some of the detailed points involved. No attempt has been made to give ideal forms, but merely such as have been found useful and sufficiently legible in practical drafting room work—that is such of them as have not been shown as a negative illustration, regarding what ought not to be. Such opinions as are to be expressed must be taken by the reader simply as opinions, which are not intended to be uttered in any didactic sense, as there are doubtless other forms and methods of both figuring and sketching which may, from some other standpoint, be just as good or better.

In group 1 is shown a desirable style of figures, letters, etc., which are easily made, are very legible, and which, as far as possible, have each an absolutely definite meaning. Exceptions to this obviously exist in the case of a 6 when turned upside down resembling a 9, a nought resembling a letter O, a minus-mark resembling a dash, and a decimal-point a period. These are, of course, foolish inconsistencies of our system of notation, which we will have to wait a few generations yet for the common sense of the world to alter. Meanwhile, the "six" difficulty can be remedied by having a definite rule as to the direction in which dimensions should read, as in the sketches, where they always read from left to right, and from bottom to top. Cases will sometimes occur in diagonal measurements where this will not be strictly adhered to, but the ordinary foot (') and inch (") marks after a figure will always show which is the top, and which is the bottom thereof, providing they are present. It is often convenient, however, to omit them where the general rule, as in the drafting-room under my control is, that all figures mean inches, unless it is otherwise expressed. Practically the confusing of a letter O with a nought rarely causes trouble, and the context usually makes the meaning plain. A minus-mark can be distinguished from a dash by carefully observing the rule to put it halfway up the height of the figures, instead of near the bottom, and the same rule will apply to a decimal point, which should be placed as at the beginning of line 6th. There is no danger of confusing a figure 1 with an I, if the tail is always put at the top of the former, as in line first, and the I made perfectly plain, as in line second, if Gothic letters are used, or with its proper double tails in the case of Roman letters. In order to absolutely distinguish a figure 1 from a 7 the latter should always be made with three strokes, as shown in line first. Otherwise it may be impossible to identify the seven, especially if it is made, as is often the case, like that shown in line first, group 2, which closely resembles the figure 1 in line second of the same group. These little details should be the subject of absolute rules in any well-regulated drafting-room, as should also the position of various vulgar fractions, in order that they may be rigidly definite. The correct position of the fraction-line is, of course, horizontal, as shown in line 6th, at any rate, as regards mixed numbers, and also fractions with more than one figure in the numerator. The contrary method speaks eloquently for itself in lines fourth and fifth of group 2, in each of which the first and last fractions are tolerably definite, and could probably be depended upon for guiding the production of a few thousands of dollars worth of work. As, however, the intermediate second and third fractions, in which a regular gradation of stupidity is shown, are very likely to be made by a careless or hurried draftsman, this system should be absolutely prohibited. In this matter I speak from experience as well as theory, having once lost a considerable number of dollars by some figures about as well made as the third fraction in line fifth of group 2, being read as fifteen-sixteenths, and a large number of small shafts having their ends turned down to that size instead of the one and five-sixteenths which was intended.

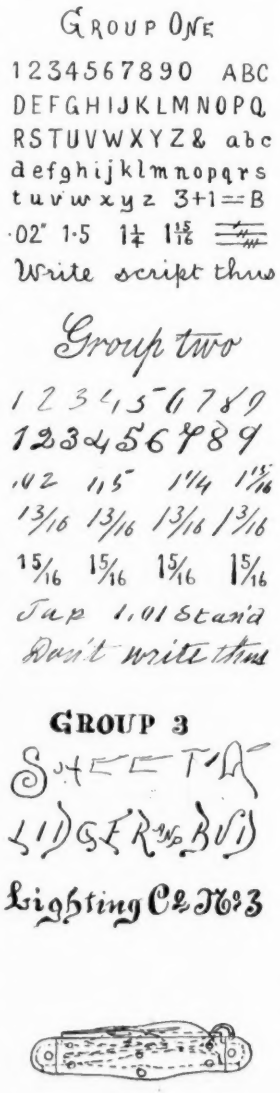
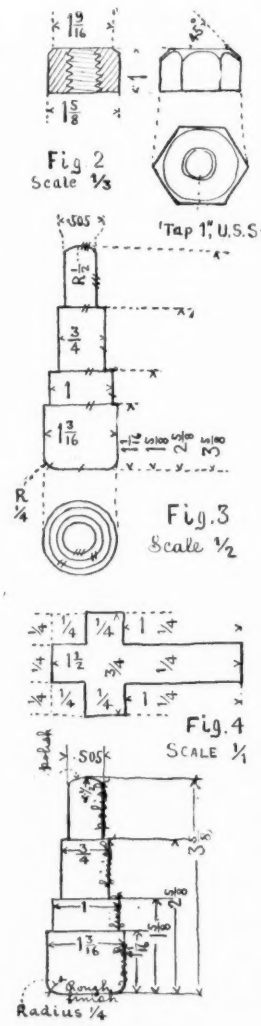


Fig. 1

As will no doubt have been already comprehended by the reader, group 2 is intended in general as a "terrible example," but the figures therein shown are no worse than thousands which I have seen upon otherwise decently made drawings. In lines first and third is shown what may be termed the inconsequent style, where a saving of time and ink seems to be the chief desideratum. This is largely practiced by the rising generation of American school children, to the disgrace of the school boards and teachers, who allow the embryo mathematicians of our generation to work out their "sums" upon the general "scatteration" principle, especially as regards the poor, unoffending numbers 4 and 5, which are so frequently dismembered in the cold-blooded and horrible manner shown. In lines sixth and seventh are shown other specimens of somewhat this same style. In the second number of line third it is not perfectly sure whether 1.5 is intended to be written, or 45, or 115, as the decimal point is made in a slap-dash style not tending to absolute certainty of meaning. In the sixth line the figures are supposed to mean "Tap one inch, O I. standard," the O. and I. being abbreviations for "Ohio Institute," or something else which one's fancy may suggest. They look, however, more like 1.01, the intended comma being as much like a decimal point belonging to this peculiar style as anything else. In line second we have a weak attempt at what might be termed the style flamboyant.

In group 3 are shown actual specimens of lettering copied from nicely-made drawings which came into my possession from various sources, the names themselves being somewhat altered to prevent identification. This lettering is in general not so bad looking in itself, especally in the case of the second line, which is rather graceful. All of it, however, is decidedly open to the objection of illegibility, especially the first line, where "Sheet A" is intended to be written, and where the "A" might mean various other things, from a map of Italy down to the inscription on a pack of Chinese fire-crackers. In regard to ornamental lettering in general, a draftsman should of course be allowed considerable discretion, and I would be the last one to thwart any really artistic work which he might be able to embody in his inscriptions. It seems to me, however, that for practical working drawings a style as easy to write and as legible as the words "Group one" is sufficiently ornamental. The script in the words "Group two" is hardly legible enough, nor is it sufficiently easy to make if written with care enough to look well; while, if not thus carefully written, it will look as school boyish as the specimen in question. If Roman letters are attempted, as in the words "Group 3," the results are apt to be nearly as ugly as I have made them, that is if much haste is attempted, as it is difficult in this style to get a good result with rapid manipulation. By a little watching of the various assistants belonging to his staff, however, a judicious head draftsman, with proper ideas upon the subject himself, will soon be able to check undue ornamentation, while at the same time attaining desirable æsthetic results—and this without insisting upon absolute uniformity of style.



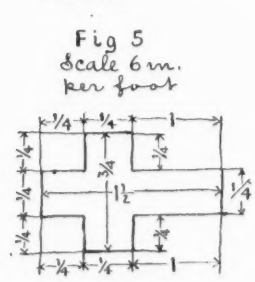


Fig. 6
Scale real size

In order to make drawings as *accurate*, *definite*, *complete*, *simple* and *neat* as possible, in accordance with the desirable attributes expressed by these adjectives in my first paragraph, one important point is to avoid as much as possible the showing of a great many concealed forms by dotted lines, for the sake of making only one picture of a given view of the object. This evil is hinted at in the side view of an ordinary pocket knife, shown in Fig. 1, where the outlines of the various springs, blades and other blade-like tools appear in dotted lines. This is, however, but an innocent specimen. The most conspicuous example, perhaps, of this sort of work that we have in ordinary conventional drawings is found in the views of locomotives, as they are generally shown in technical publications, and in the drafting-rooms of the locomotive shops themselves. I will not venture to positively criticise this practice, as the experience of makers of these machines may have shown them the desirability of such representations, rather than a simpler system of drawings with a greater number of views taken in successive planes one behind another. These drawings as they now exist certainly outdo in confusion of lines the *Harper's Bazaar* fashion diagrams, so dear to our womankind, without having the merit of a different kind of line for each particular idea. Of course, no definite rule can be laid down to govern this matter, but the practice of a general principle of simplicity will lead in many cases to making more views with less lines in each—also to the omission of all concealed forms in dotted lines except where positively necessary.

In Fig. 2 is shown a specimen of figuring an ordinary hexagon nut, with perhaps the fewest lines and characters possible to express the whole idea involved. The figuring here is entirely "exterior." In Fig. 3 is shown a finished stud, exterior figuring being used for the length and "interior" for most of the diameters. The lengths are here figured progressively, counting from the bottom end. This style is not always the best, successive figuring, as shown across the top in Fig. 6, being sometimes preferable. Which of these two styles to use is mostly dependent upon the method employed by the machinist in constructing the article. If, for instance, he will probably wish to put the end of his measuring rule against a shoulder of some kind upon the work, or against the face of the chuck in which it is turned, or perhaps against a special gauge projecting therefrom, this progressive style is more accurate in its results and enables him to take direct readings from his rule agreeing with the measurements given. The successive system, on the contrary, would require a number of mental calculations, with consequent danger of errors. If with the latter system, in order to read direct, he works by the step by step method, measuring off to the first shoulder, then from that to the second, from that to the third, etc., the danger of *cumulative errors* comes in. In some cases this is of no consequence, but in accurate work a bad result is frequently obtained.

It may be related, *en passant*, that cumulative measuring was, in one form, practiced by the present writer upon a certain occasion when, as a small boy, he was induced by maternal influence to saw up a number of old 12-foot fence rails into fire wood. He was furnished with a small stick of wood as a unit of standard measurement, which stick was supposed to personate the longitudinal axis of the fire-box of the kitchen stove, a due allowance for clearance having been made at each end. Instead, however,

FIGURING DRAWINGS.

of using this standard rod to represent the desired constant, this youthful operator took the liberty of using the last stick sawed off each time as a measure for the next one, in most cases carelessly allowing a certain excess which he assumed would be covered by the clearance before mentioned. There was doubtless method in his madness, for he had a sneaking feeling that this system might require one less saw-cut or so in each rail, thus lessening the sum total of his unhappiness. When, however, the kitchen stove indignantly refused a number of the last sticks cut, each having to be sawed in two by a separate operation, the question of the aggregate happiness of the boy was naturally an open one.

In case of using successive measurements it is usually best to also give the total length of the object, as in the center of Fig. 6, this length, of course, representing the sum of the partial ones. In some cases a mixture of the two methods in question is convenient. In general, it may be said, that there are so very many ways of figuring that no particular system can be adhered to. Each drawing must be figured to suit the particular conditions pertaining thereto, with, as before mentioned, an especial view to the convenience of the man who reads and works from it, in avoiding additions, subtractions and other mental labor. The same condition of uncertainty as to any standard exists in regard to internal or external figuring. Where there is plenty of room as in Figs. 3 and 4, and where the surface is not so darkened by section-lines or other shading, as to obscure the figures, the inside method is simpler than putting the figures outside.

It will be noticed that in Fig. 3 certain of the lines are crossed by small diagonal marks, a set of which are shown separately, crossing special lines of their own, in line sixth of group 1. These are conventional marks used by the writer for many years past with great success, and with all sorts of workmen, new and old, for designating the kind of finish to be put upon a surface. The absence of any such marks, as in the lower section of Fig. 3, means that the surface is to be left rough, one mark means a ground, filed or polished finish without special truth or accuracy, two marks a regular machine finish as left by lathe, planer, miller, etc., and three marks the same sort of a surface highly polished. These are, of course, not perfectly definite as to the degree of polish, etc., but in an occasional special case they can be supplemented by written directions. They have been found to serve an excellent practical purpose and are commendable on account of their extreme simplicity, as well as the small amount of room they require. They are offered here only as suggested substitutes for the method often used of writing the word "finish," etc., upon the surface to which it applies, as is shown in Fig. 5. This is troublesome to write, and in many cases there is much crowding for want of room. In Fig. 3 it will be noticed that the upper diametral measurement is exterior, and that the dimension lines are offset outward to get room to clearly write the decimal required between the pointers, when placed in their natural position. This seems to me much preferable to reversing the pointers, as is sometimes done, and as is shown in Fig. 5 for the same measurement. The latter method inverts the usual meaning of a pointer, but does not make its meaning perfectly definite. Another conventional method of my own which I have found convenient is to mark all radii by a capital letter "R" simply, never using this symbol for any other purpose. I have always found it good enough to follow this "R" with the figures representing the radius desired, connecting it with some part of the arc described by such radius, with a dotted line. It is immaterial whether this be inside the arc, as shown at the top of Fig. 3, or outside, as shown at the bottom. This method is certainly simpler than the ones often used as shown in Fig. 5, it being entirely unnecessary to put one of the pointers at the center from which the arc is divided.

Among other rules of my own practice is the abandonment of heavy shade-lines upon certain edges of a drawing, it being preferable, in my opinion, for facility of measurement and for rapidity of execution, to make the lines of the drawing proper all alike, heavy enough to be clearly visible, but light enough not to cause doubt about what part of the line to measure to in cases of transferring, and verifying and working from drawings, etc. In thus speaking of "working from" drawings, I do not, of course, mean to say that a machinist should be expected to measure a drawing with his rule in finding the sizes he wants. This in these modern days should be entirely out of the question, as all the measurements he needs to use should be clearly figured. It is often the case, however, that in pattern and tool making, etc., certain measurements are required from a scale drawing which are not, and need not be figured—being perhaps used only once. It is therefore an important point that the lines should be definitely and accurately made, and that there should be no question about whether to measure to one side or the other of an extra heavy line. In my own practice I have also adopted, absolutely and always, the *direct* method of revolution in placing of views, rather than the *indirect*. This, however, with draftsmen at large, is still, unfortunately, an open question, and must, I am afraid, remain so until some general consensus of opinion shall have been obtained, and a standard adopted which all of us will conform to.

It goes without saying that lines not belonging to the drawing proper, such as center-lines, dimension-lines, pointers, etc., should, as before mentioned, appear in a different color, if possible, and should usually be dotted rather than solid. If, however, the color must be the same, as in a blue-print, it is still more important that the lines should not be solid, and that they should be very much lighter than the lines of the drawing itself.

One particularly pernicious practice which I most emphatically inveigh against, is the encumbering of a drawing with unnecessary pointer lines, either interior or exterior thereto, as shown in Figs. 5 and 6, and as is done by so many draftsmen. I am aware that it is considered the conventional and proper thing so to do, and that sometimes it is necessary, especially in cases of long distances upon large drawings, where uncertainty or confusion might result from their absence. It is a fact, however, that in numerous instances, especially in small sketches or drawings, these lines can be omitted, as is clearly shown in Figs. 2, 3 and 4, where it would be impossible for any reader of the drawing to make a mistake as to where all the given dimensions were intended to apply. The objection to these pointer lines is not only the trouble of making them, but more especially the confusion which they make in the general appearance of the drawing, especially if they are drawn as solid lines nearly or quite as large as the lines of the drawing itself, as is so often the case. Thus the cross shaped figure shown in Fig. 6 has the general appearance of a rectangle, by reason of these false lines. Such interior pointer-lines moreover, as shown in Figs. 5 and 6, often appeal to the eye at first sight, as parts of the drawing, and are apt at times to cause confusion—at any rate, until close inspection has been given, especially when the drawing is new and strange to the observer.

It will be noticed in Fig. 4 that in some cases the pointers themselves are omitted. This departure from general practice is, I think, permissible where figures have to be crowded in small spaces, and where there are a great many of them, not only on account of saving the trouble of drawing the pointers, but to avoid confusion in the appearance of the drawing, which looks cleaner and more definite without them. It certainly cannot be said that in Fig. 4 there is the slightest danger of confounding any one of the measurements with any other one. Another departure from the general rules stated earlier in this article, is shown in Figs. 4 and 6, in the matter of sloping fraction-lines, instead of horizontal ones, in certain cases. It will be seen that they are easier to make and take less room, being entirely unobjectionable on account of possible indefiniteness of meaning. It will be observed, however, that such sloping lines are used only where the numerator and denominator each consist of but one figure, and where there is no mixed number. I would, therefore, in the rules of a drafting office allow exceptions to the general rule of a horizontal fraction-line in these cases and in no others.

At the extreme right of Fig. 6 is shown a mongrel style of figuring which is becoming too prevalent where the reading is at right angles to the direction of the measurement, instead of coincident with it as usual. This is apt to cause mistakes in crowded places. If the writers and readers of these figures cannot run them upward as well as sideways they should learn how, without delay.

In Fig. 2 it will be noticed that instead of giving a number of dimensions pertaining to the thread tapped in the nut, directions are simply given to tap it "U. S. standard." Such marking, of course, simplifies matters and can always be applied where well-known and recognized standards are used in constructing the work to which the drawings pertain. It will be noticed in Figs. 2, 3 and 4 that the scale of the drawing is figured simply as a fraction, the numerator always referring to the drawing, and the denominator to the real size of the work. This is certainly less trouble to write than the methods shown in Figs. 5 and 6, and appeals at once to the common sense of the reader, where, if a drawing is marked "1/2," the natural inference would be that it is one half of real size, etc. Scale "1/1," of course, always means full size, and the same system is just as good when the drawing is larger than the work, as is often the case in watch factories, etc. In such cases the notation would be simply scale "2/1," "4/1," etc.

Speaking in general, the styles of work hinted at in Group 1 and Figs. 2, 3 and 4, represent fairly good practice, while how-not to-do it is exhibited in several of the features pertaining to Figs. 1, 5 and 6.

Master mechanics and others who are connected with railroads have done much good by their efforts to secure the adoption and maintenance of standards and uniformity in the mechanical and operating departments, and they will, therefore, appreciate somewhat the desirability of bringing about a uniform system of railroad accounting, one result of which would be that financial statements and reports pertaining to railroads, and intended either for the information of directors, stockholders or the general public, would be alike—based upon the same system of accounting and consequently readily comparable one with another, and intelligible. Such a system, if it could be brought about, would do away with many opportunities for rascality, and would, we think, be likely to do much to improve the business of railroading in many ways.

A particularly disastrous boiler explosion took place at Sulphur Springs, Ark., on the 20th of September, by which one man was instantly killed, five or more fatally injured, and ten others injured more or less seriously. It was a boiler in a saw-mill where fuel cost nothing and where consequently there was no reason for employing a competent engineer; at least, no reason which "touched the pocket nerve."

We have received from the Wells Memorial Institute, 987 Washington street, Boston, Mass., a prospectus setting forth the work which the Institute proposes to do during the coming winter for mechanics and workingmen of Boston, who may choose to avail themselves of the privileges offered. The prospectus sets forth a very attractive programme of lectures, entertainments, etc., and gives information in regard to other substantial benefits to be gained by membership. The membership fee has been reduced to $1.

LETTERS FROM PRACTICAL MEN.

Economy in Melting.

Editor American Machinist:

In the September 6th issue Mr. F. B. Shaffer asks a question which calls for an answer. I will say that it was a most unpardonable omission on my part in not mentioning the details asked for. The material melted was stove scrap and street car wheels. The fuel used was 18 inch bed, foundry coke. The work it was used for was marine-way rolls principally. The shop work is general jobbing.

Jackson, Fla. E. O. Sawyer.

Fraudulent Testing.

Editor American Machinist:

Your editorial statement at the end of my letter on "Fraudulent Testing" in your issue of September 20th, brings the discussion to the same point that the discussion of the statement that a live fish added to a pail of water would not increase its weight was brought, when the king said "let us try it and find out." Can you not get some of your readers who have testing machines at their command to make the trial?

The question at issue is "Does the machine when run rapidly register a greater stress than actually exists in the test piece, and, if so, why?" It is a different one from the other question which may be confused with it, "Does the test piece offer a greater resistance to rupture when it is stretched rapidly than when it is stretched slowly?"

If we test a piece rapidly, and the machine indicates a higher resistance than it indicated on a duplicate piece tested slowly, both of the above questions arise. Is the higher registration due to increased resistance of the piece itself, or to false registration of the testing machine?

In making tests to determine the effect of rapid testing, it must be borne in mind that results obtained from a few tests are not conclusive, for two test pieces from the same bar may vary considerably in strength. If twelve pieces were cut from the same plate, and six tested rapidly and six slowly, the average result might lead to some conclusion. Wm. Kent.

Passaic, N. J.

Train Motion and Resistance.

Editor American Machinist:

In your issue of September 27th you published an article entitled "Train Motion and Resistance," in which the statement is made that "the tractive power of an engine bears a *definite ratio to the weight on drivers.* Haswell gives the following values of this *coefficient of adhesion*, as it is called," and a table is appended. The italics are mine. I hold that there is absolutely no connection, definite or indefinite, between the weight of the engine and the tractive force. In other words, adhesive power and tractive force are *not* the same.

Again, he gives as a formula to obtain the maximum velocity attainable by a train

$$V = \sqrt{\frac{K}{C\,W}},$$

in which V = velocity; K = tractive power; C = empirical constant.

The above formula is to my mind meaningless, or, rather, worthless. I believe firmly that the tractive power is expressed very closely by the formula

$$K = \frac{d^2 \times l \times M.\ E.\ P.}{D},$$

where d = diameter of cylinder in inches; l = stroke in inches; $M.\ E.\ P.$ = mean effective pressure in pounds per square inch; D = diameter of drivers in inches.

This formula is given by Haswell and J. G. A. Meyer.

Now, in order to get the mean effective pressure we must assume the piston speed; for the higher the speed, the smaller the per cent. of boiler pressure realized as mean effective pressure, and this per cent. varies from 85 per cent. at very slow speeds, barely moving, to only 25 per cent. at very high speeds, such as 999 was guilty of when making her great record. Now, when you assume your velocity to find your velocity,

you don't seem to do very much. Then again, I assume all these things, and the velocity I found by his formula isn't the one I assumed. I wonder why?

I think his error lies in assuming that tractive force and adhesive power are interchangeable terms. Will Mr. Horton reconcile these differences?

C. W. MacCord, Jr.

Die Making.

Editor American Machinist:

I have during the last few weeks received several orders for press work, with the satisfaction (?) of knowing that the dies were all made by a first class firm in Chicago, and in good order.

Now, we home made mechanics west of the lakes don't pretend to know so much as our brother die-makers in the East, but it might interest you to see what I have got.

Fig. 1 shows two pieces of No. 22 soft steel riveted together at a a^1. There are four $\frac{9}{16}$ holes at b b^1 for riveting a leather strap, and raised ribs at c c^1 to strengthen it. The larger blank is $5'' \times 5\frac{1}{4}''$, and the smaller $5'' \times 2\frac{9}{16}''$.

To blank, perforate and bend this I got ten sets of dies, or five operations for each piece.

As the order called for 25,000, and the contract was signed, I saw "I was in for it," as the patentee insisted upon it that the dies were all right and in good order, and was not going to spend any more money in dies. When I heard the price he paid, I didn't blame him.

The blanking dies were of the common style—tool steel welded onto machine steel.

The perforating dies were solid steel blocks without bushings. I find that in case I have to punch the holes in a second operation, a cast-iron plate with bushings is cheaper, and if something should happen to one it can easily be replaced. The first forming die "broke" both sides down square, and the second was a horn-like affair to curve the sides, one side at a time.

Fig. 2 shows my blanking and perforating die, if it can so be called. It is a steel block, $6'' \times 9'' - \frac{3}{4}''$ thick, bolted on to a cast-iron plate with four $\frac{5}{8}$ screws, which at the same time clamp the stripper, which in this case is removed. The holes are identical with those shown in Fig. 1, and for punching the smaller blank I remove punches a a^1 and b b^1, leaving c c^1 to match a a^1 in the large blank. I get my stock 5" wide, and by changing the gauge for the different lengths I cut both blanks with the same die.

In Fig. 3 will be seen my forming die: X is a finished blank; A is a cast iron plate; b b^1 are tool steel, having the same curve as punch p and pattern in Fig. 1; C C^1 are two hardened cams which will, when the punch is coming down, press b b^1 forward and form the required shape. When the punch goes up again b b^1 will slip back, and the blank will hang on to the punch and will readily come off. The cams are double, working front and back. The punch is projecting $\frac{1}{2}''$ on each end to engage the cams.

The dies cost about $30, but then I have reduced 250,000 operations to 100,000, plus 150 pounds of scrap steel, cast iron and cap screws. P. D.

Maxim's Flying Machine.

Editor American Machinist:

A friend of mine connected with the scientific press in London has been kind enough to send me your publication of the 6th inst. This gentleman was aware of the fact that Mr. Stevens was a relative of mine to whom I had paid a large salary, and whom I attempted to push forward in England. After referring to "the animus obviously displayed in Mr. Stevens' letter to the American Machinist," he says: "This does not surprise me in the least. The proceeding is quite in accordance with the ordinary maxims of applied philanthropy. So far as I have seen from a pretty extensive survey of the American general press, the editorials and descriptive articles on your flying machine — amounting, I should say, to about a dozen yards of printed matter—are quite of a contrary tendency to this isolated instance, to which, considering its singularity, I thought it worth while to draw your attention."

It is very gratifying to me that the American press has spoken so favorably of my experiments. When one makes a new departure such as I have done, he lays himself open to criticism, and I must admit I expected a great deal of it. But it would appear that there is only one party so far who has ridiculed my experiments, and I think the spite displayed in this letter is so obvious, that any one can see that it cannot be considered a fair criticism.

As to the reason and logic of Mr. Stevens' letter, I beg to offer a few remarks.

In speaking of the admirable experiments of my old friend, Professor Langley, Mr. Stevens says that Professor Langley lifted as much as 250 pounds to the horse power, while with the experiments which I tried

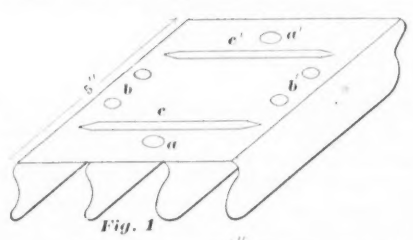


Fig. 1

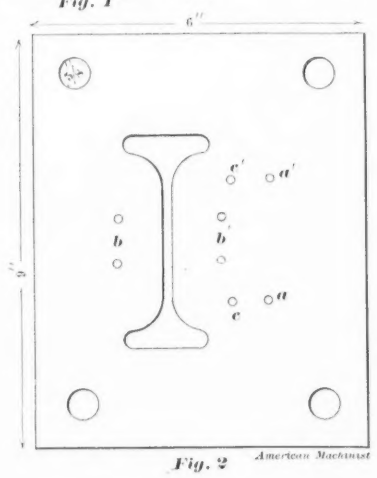


Fig. 2 American Machinist

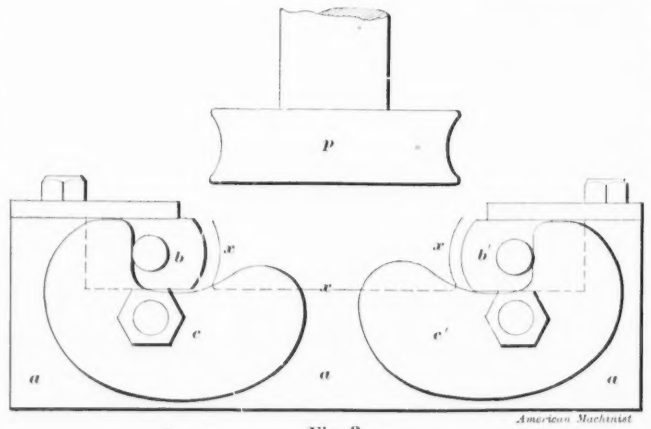


Fig. 3

Die Making.

with a similar apparatus, I only lifted 133 pounds to the horse power, and in my latest completed machine, only 25 pounds to the horse-power. This, to Mr. Stevens' mind, shows that I am vastly inferior as an engineer to my co worker, Professor Langley. Professor Langley in making his calculations only considered the power necessary to drive a very small and rigid plane through the air. The machinery, the wires, the bracing, and the stays were not a factor at all. Professor Langley's steam engine was on the ground, and the power was transmitted to a revolving arm to which the small aeroplane was attached. The calculations were made with a view of ascertaining how much power was required to drive the aeroplane and nothing else through the air; also to show how much the plane would lift. The result was 250 pounds to the horse power. In similar experiments tried by myself, I used planes from twenty to one hundred times as large as those employed by Professor Langley, but instead of computing *only* the power for driving the plane, I computed the power required for driving the propelling screw, *and* the plane, consequently, I had the factor of slip to deal with, and some other factors which were not considered in Professor Langley's calculations. Under these conditions it was possible to carry about 100 pounds to the horse power. But when I came to make a very large machine, and it was necessary to have a good deal of frame work to carry my engines, boiler, water, tanks, machinery, and men with me, the conditions were not so favorable, because there was a great deal more material to offer resistance. In these experiments the greater part of the power was lost in screw slip and atmospheric resistance as might have been expected; nevertheless, I lifted 10,000 pounds with an expenditure of 363 horse-power, or rather more than 27 pounds to the horse-power, but then the machine had been so constructed as to present very sharp angles in order to lift quickly on a short track at starting. When the machine was once in the air, the angle could be changed when the power required would be considerably less.

I note what Mr. Stevens says about the advantages arising from small and light machines. This he has copied almost verbatim from the instructions which I gave him in regard to working out details of a smaller machine which I was building before I left for Constantinople.

In regard to a new material being necessary, I would say that my side wings are 27 feet long; they are of steel tubes stayed with very strong steel wires to a wide base. I do not think engineers would consider this beyond the limit of hard steel. An engineer who compares a machine which has lifted itself and its motive power off the ground, with a barn door, is evidently so incompetent or so prejudiced as to render his criticism absolutely worthless.

Mr. Stevens also has something to say about an aerial torpedo. This is taken from an article which I wrote for the *Fortnightly Review*, of October, 1892, and which was one of the articles which I gave Mr. Stevens to read while he was here.

The advantages are not all in favor of small machines, as Mr. Stevens supposes. Comparatively large engines will develop more power per unit of weight than small ones. The larger the machine the smaller the factor of the weight of the men necessary to operate the machine. Moreover, a great many experiments have already been tried with smaller machines, and in every case they have persistently stuck to the ground.

It is not true that Mr. Stevens was present at the experiments which he refers to. He never saw the new machine which was experimented with the last of July, he having been discharged in March.

He claims to have run my engines "on many occasions." This is not true. No one has ever run these engines except myself. * * * Hiram S. Maxim.

Baldwyns Park, Bexley, Kent, Eng.

[It is perhaps proper for us to add that the conclusion of Mr. Maxim's letter as written is a statement of reasons for alleged personal animus. We do not print this because if flying machines are to be discussed in our columns, we prefer to have them discussed upon their merits, and not upon a basis of personal disagreements. We should add also that, in our opinion, Mr. Stevens' letter does not give evidence within itself of personal spite or ill feeling, whatever may have been his motives in writing it, of which we could, of course, have known nothing.—Ed]

Silicon Pig-iron.

Editor American Machinist:

I have before me four samples "Keep's test" bars made from as many different kinds of pig-irons, which were melted in a crucible in an ordinary brass furnace, using Connellsville coke.

The chemical analysis of the pig-iron is as follows:

No. 1	sample	silicon	2.15	per	cent.
" 2	"	"	2.54	"	"
" 3	"	"	2 61	"	"
" 4	"	"	4.17	"	"

And the chemical analysis of the "Keep's test" bars made from the above irons, is as follows:

No. 1	bar	silicon	1.90	per	cent.
" 2	"	"	2.10	"	"
" 3	"	"	2.35	"	"
" 4	"	"	3.75	"	"

Physical test:

Bar No. 1	shrinkage	.170,	chill	all.
" " 2	"	.155	"	.06.
" " 3	"	.170	"	.18.
" " 4	"	.175	"	.15.

Now, what I would like to know is this: Mr. Keep claims that the higher the silicon, the lower the shrinkage and chill, but as you will find from the above figures, this is not the case or fact in my tests, for instance, the No. 4 test bar being made from No. 4 pig iron, which contained 4.17 per cent. silicon has the greatest shrinkage, and a much higher chill than No. 2 sample (which was made from No. 2 pig-iron) the same containing only 2.54 per cent. silicon, and at the same time it is the lowest both in shrinkage and chill, being, respectively, .155 and .06.

If Mr. Keep can explain where I am wrong, I as well as many other readers of your valuable paper would be pleased to hear from him. Ph. Mathes, Supt.

Brittan, Graham & Mathes.

Pittsburgh, Pa.

"A Wonderful Cupola."

Editor American Machinist:

In the article, "A Wonderful Cupola," of your September 27th issue, at the ending of your foot note you say, "that it becomes a mystery." If you will read what it says—"and help to burn escaping gases of the melting zone," it will no longer remain a mystery.

If a certain amount of oxygen is let in to meet the carbonic oxyde gas, escaping above the melting zone, combustion must be the result. Instead of gas coming out in the blue flame, he says "no flames escape out of this cupola when at work." Consequently the air he puts in these small pipes produces combustion, which of necessity must help prepare the coke and the pig iron, to meet the melting zone, in a much hotter condition than it otherwise would.

It seems to me that this explanation is perfectly plain, and that there is no mystery about it. W. A. Sweet.

Editor American Machinist:

I note your remarks on the performances of Mr. Bollinckx' cupola in your last issue, and fully agree with you that it is "mysterious." If you will turn to the May 17, 1884, issue, you will find there an account of some pretty good melting, in an English cupola, by M. J. Wheatley. He reports a duty of 1 pound coke to 17 pounds iron, which discounts our practice in this country by a very respectable margin. As all the data and methods of charging are given, there seems to be no doubt as to its genuineness. In the same paper—and here is the important point—Mr. Wheatley calculates the theoretical quantity of iron melted per pound of coke and comes out with about 1 : 22. I have looked over the calculation and see no flaw in it. It is probably as near as such calculations ever are. Now, inasmuch as Mr. Bollinckx is melting at the rate of 1 : 22.6, or *above theory*, I am naturally a little skeptical. To be sure, Mr. Wheatley assumes the coke "burnt to carbonic acid," and bases his calculation on this assumption; but I agree with him that it is, all considered, a fair assumption. As to the arrangement of auxiliary tuyeres shown by Mr. Bollinckx, the same device, or something very similar, is in use on cupolas in at least one of the large steel manufactories of this country, and I have heard it mentioned

a number of times with considerable praise, but I had no idea its power was so phenomenal as to permit of a theoretical result in melting iron. JOSEPH TORREY.

A Vibrating Water Fall—Peculiar Rope Drive.

Editor American Machinist:

This summer the writer's attention was called to a peculiar ticking noise, similar to that known in the rural districts as the "Death-watch," which was caused by the windows vibrating in a house at which he was staying. On pressing the sash to one side the noise would cease, but a faint vibration was noticeable in the center of the window. On being told that it was caused by falling water over a dam some distance away, and investigating the matter with a friend we found that the dam which, as shown by the sketches in Fig. 1, followed the stream for 200 feet, and at the upper end ran across to the opposite bank, and over which the water flowed for most of the distance, showed nothing of importance except at the part included between the arrow heads.

At this point the bank rises almost perpendicularly, to a height of 30 feet, and is about 8 feet away from the face of the dam. The latter, about five feet high at this point, is built in the usual manner of logs placed crosswise over each other, planking being nailed to the logs on an angle at the front side, while the back is left open. At a certain height of flow over the weir the water falls with a peculiar wavy motion, striking the rocks below with a noise similar to that caused by a small paddle wheel. At a lower or higher depth of flow this motion disappears. The vibrations seem to follow the fall of water past the logs—that is, a particle of water seems to go in and out as it alternately passes the logs and spaces. This vibration is communicated to the house, which is about 500 feet away, in the direction shown by the arrow. When the vibrations at the dam cease so do those at the house and *vice versa*.

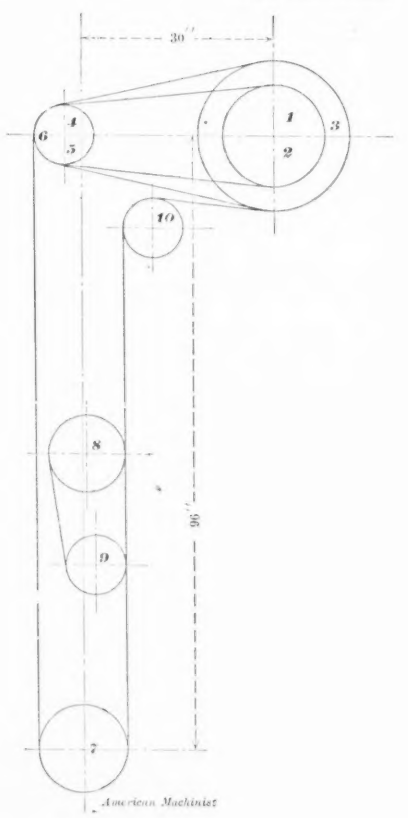
One theory given is that the water in falling over the face of a log causes a vacuum at that point due to the velocity with which it passes the latter. This would tend to draw the stream of water closer to the log. As the water alternately passed the log and space it would also move in and out, since when opposite a space there would be no disturbance. The bank, according to this theory, acts as a reflector of the vibrations, tending to make them more severe, since they are not noticeable at any other part of the dam, though in some places the fall is 25 feet.

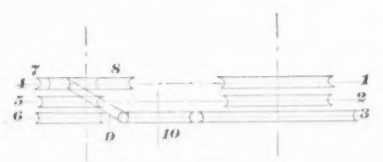
Perhaps some of the readers of the AMERICAN MACHINIST may have had similar experiences and can suggest a remedy. While sheathing the back of the dam has been suggested it is rather expensive, though probably effective.

Before leaving the subject it might be well to say that at a higher level the vibrations do not occur, probably due to the heavier body of water, while at a lower depth the stream becomes divided into a number of parts and allows the air to get underneath, thus stopping any vibration.

The question of short-rope drives, which came up in a conversation a few days ago, recalled to memory the drive used on the spinning mules in a woolen mill with which the writer is acquainted. The machine is of English make and the spindles are driven by a long cylinder, which in turn receives motion from a half inch cotton rope. This rope is smeared with a preparation of tallow, molasses and plumbago, and after running a short time has a firm glossy surface. They last on the average from 8 to 10 months and give but little trouble, transmitting from 2 to 2½ horse-power. The dimensions given, are approximately correct, and sufficiently close to give a fair idea of the conditions under which the rope has to work.

In the side and end elevations of the drive shown in Fig. 2, pulleys 1, 2 and 3 are the drivers, 3 being a 24 inch pulley connected through a quill to one of the main-belt pulleys, while 1 and 2, in reality one pulley with 2 grooves, having a diameter varying with the quality of yarn to be spun, 16 inches being an average size, are connected through a shaft to the other belt pulley, an idler running between similarly to the single belt shifting device used on some planers. The rope is alternately driven by 1–2 or 3. 4, 5, 6, 9 and 10 are 9 inch idlers, 7 is a 14-inch idler, while 8 is the driven pulley attached to the long cylinder. Pulleys 8 and 9 travel in and out with the frame.





PECULIAR ROPE DRIVE.

The rope starting from 1 runs over the pulleys in the following order: 1, 4, 7, 8, 9, 10, 3, 6, 2, 5, and from there back to 1. As the frame moves out, the pulley 1–2 drives the spindles, the average rope speed being about 1,750 feet per minute. At the end of the travel the belt changes over to 3, which increases the speed to about 2,500 feet per minute, and on coming in again a friction clutch is thrown in reducing the speed almost instantaneously to 250 feet. Thus a complete cycle from 0 to 1,750, 1,750 to 2,500, 2,500 to 250, and 250 to 0, is made every 1½ to 2 minutes, which throws a severe strain on the rope.

Little as we care to design work not in accordance with what we call good engineering practice, yet often the conditions to which we must conform compel us to make the best possible compromise. This case furnishes a good example of the kind, and may be of interest to some of your readers.

WM. SANGSTER.

Lift of Hot Water.

Editor American Machinist:

It sometimes happens that it is desirable to know how high hot water can be lifted with a suction pump, and having had such problems to solve, I devised the following formula to aid me, and which may be of interest to others:

$$L = \frac{(A - B)}{\left(\frac{W}{144}\right)} \times 0.8.$$

L = the vertical distance in feet the water can be lifted by suction in practice.

A = absolute pressure per square inch existing on the surface of the water to be lifted, which, in cases of open tanks, is atmospheric pressure, say, 14.7 pounds is sufficiently accurate.

The values of B and W can be determined from the table following:

Water Temp.	B.	W.	Water Temp.	B.	W.	Water Temp.	B.	W.	Water Temp.	B.	W.
40	.122	62.423	90	.693	62.119	140	2.879	61.388	190	9.335	60.366
50	.178	62.409	100	.942	62.000	150	3.708	61.204	200	11.526	60.136
60	.254	62.367	110	1.267	61.867	160	4.731	61.007	210	14.127	59.894
70	.360	62.307	120	1.685	61.720	170	5.985	60.801			
80	.503	62.218	130	2.215	61.556	180	7.511	60.587			

ROBT. D. KINNEY.

"A Brilliant Item."

Editor American Machinist:

I have to thank one of your correspondents for pointing out in your columns two errors, by volume, number, page, etc., two errors in an article of mine in an issue, two years old, of another publication. "Tons" was given for "pounds," and "separate lamp" for "spirit lamp"—both amusing stenographers' errors, which misled no one.

But just why he should have chosen the AMERICAN MACHINIST instead of the journal in which the errors appeared two years ago, is a mystery, as the matter certainly could not interest the readers of the AMERICAN MACHINIST, and I do not remember ever having done your correspondent either an injury or a favor—either of which sometimes makes people malicious.

ROBERT GRIMSHAW.
27 Boulevard Auspach, Brussels, Belgium.

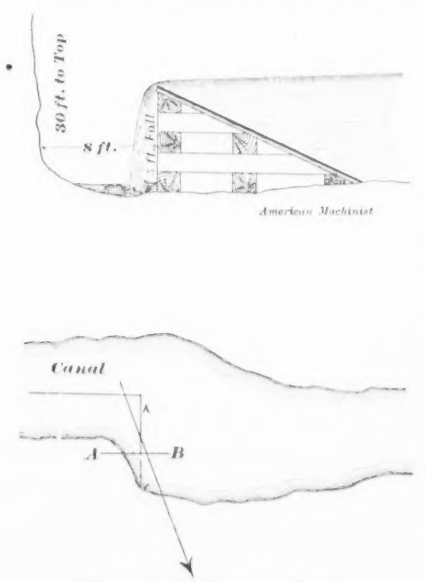
British Love of Fair Play.

Editor American Machinist:

You print a paragraph on page 7 of your issue of September 6th, which is so unfair and untrue, that I cannot let it pass unnoticed; it is that regarding the American yacht "Vigilant" and the treatment she has received in this country.

The idea of "shabby" when alluding to it must emanate from the brain of some insane crank, because I know that from first to last the universal feeling here is friendly to your yacht, and no one knows that better than her worthy owner.

Although she has had many defeats over here, still all British yachtsmen appreciate her qualities, and openly give expression of their admiration of them. W. S.



VIBRATING WATER FALL.

[We have had no "Special Commissioner" attending the yacht races in England, and our remarks were founded solely upon press reports, which we supposed were in the main correct.—ED.]

It is said that a Brooklyn mechanic has invented a machine for making binding twine which will greatly reduce the cost of manufacturing.

Foot-power Emery Wheel.

We present herewith an illustration of an emery grinder to be driven by foot-power. As to the general design of the machine this is sufficiently well shown by the engraving, and the clutch mechanism for driving was illustrated and described in detail in our issue of December 18, 1890, in connection with a portable forge on which it has since been used with entire satisfaction. It is necessary to say of this now, only that it is of the class of mechanisms for changing reciprocating into continuous rotary motion which depend upon self-applying friction devices which drive in one direction only, releasing in the other direction.

With this particular device there is no lost motion, the driving is very strong, and the action is quiet. It is also durable and little liable to derangement or failure. With this machine the emery wheel is easily driven at a speed of 3,000 revolutions per minute, and it is found a very efficient grinder for very many purposes, and can be provided with a polishing head if desired.

FOOT POWER EMERY WHEEL.

It is made by the Chapman Portable Forge Works, Marcellus, Mich.

Two men who had found an oyster which each of them claimed as his referred their dispute to a lawyer, who ate the oyster and awarded them a shell apiece. Immediately they organized the great Oyster-shell Trust, issuing $10,000,000 debentures, secured by a first mortgage on the shells, retained the lawyer as their legal adviser, purchased several Senators, and lived happy ever afterward. Moral: Do not throw away the shells, even after the lawyer has eaten the oyster.—*Boston Transcript.*

Those who have been interested in our accounts of how the modern and scientific burglar opens "burglar-proof" safes will be interested also in the plan of an Indiana merchant to prevent his safe being blown open. He posts a notice on the safe as follows:

"Mr. Burglar, please do not break open or deface this safe. It contains books and papers valuable only to me. If you wish to see for yourself the combination is as follows: 46 back twice 73, forward once to 96, back to 51. If you open the safe please close and lock it for fear of fire."

His safe, it seems, had been blown open several times, and the expense resulting from this destruction had become burdensome.

AMERICAN MACHINIST

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NEW YORK, OCTOBER 11, 1894.

CONTENTS

PAGE.
A New Shaper.... 1
The Greiner & Erpf Cupola. By W. F. Durfee. 1, 2
Spacing Holes. By Easy Way..... 2, 3
Relay Pumps- Long Gear Teeth. By W. H. Booth 3
Ship Timber Jig Saw—Accurate Hole Locating. By James F. Hobart.. 3
Figuring Drawings. By Oberlin Smith.....3, 4, 5
Letters from Practical Men: Economy in Melting. By E. O. Sawyer... Fraudulent Testing. By Wm. Kent ...Train Motion and Resistance. By C. W. MacCord, Jr....Die Making. By P. D....Maxim's Flying Machine. By Hiram S. Maxim ...Silicon Pig-iron. By Ph. Mathes ..."A Wonderful Cupola." By W. A. Sweet ...A Vibrating Water Fall—Peculiar Rope Drive. By Wm. Sangster . Lift of Hot Water. By Robert Grimshaw....British Love of Fairplay. By W. S..... .....5, 6, 7
Foot-power Emery Wheel..... 7
A Sample Wire Gauge Muddle..... 8
Some Recent Court Decisions... 8
Soldering Aluminum..... 8
Literary Notes..... 8
Rustless Coating for Iron and Steel. By M. P. Wood 9, 10, 11
Antwerp Exposition. By C. W. Crawford... 11, 12
Manufactures... ....12, 13
Machinists' Supplies and Iron..... 13

Mr. F. F. Hemenway, who has been, for about fourteen years, connected with this journal as editor and associate has resigned. His intentions as to the future are not yet ready to be announced; but, into whatever field he may go, he will take with him the friendship and best wishes of his late associates in this office.

A Sample Wire Gauge Muddle.

The question of wire gauges is one which has, seemingly, endless phases, and presents to him who has anything to do with it an endless succession of complications and surprises. A new instance of this is to be found in our department of "Questions and Answers" this week.

In this an order was received for a job in which there were to be a number of holes drilled "No. 9 Stubs steel wire gauge." When the job was received by the customer he found these holes to be .148 inch diameter, and returned it for correction, claiming that they should have been .196 inch. Now, a person unacquainted with the vagaries of the wire gauge muddle would probably, in his simplicity, have expected us to say that one or the other of these sizes is right, instead of which we decide that neither is right, and that, by the terms of the order the holes should have been .194 inch diameter.

We may as well admit, in strict confidence, that we may ourselves be wrong in this, but at any rate, we *think* we are right, which is as much as any one ought to be willing ever to assume regarding a wire gauge.

In the case mentioned, the man who ordered the work, evidently had in mind the "Brown & Sharpe" gauge designated in their catalogue as "twist drill and steel wire gauge," in which gauge No. 9 is .196 inch diameter. But the terms of his order did not show that this was the gauge referred to, and his using the name "Stubs," led the machinist to take the gauge called in the same catalogue the "English standard wire gauge," which is declared to be the same as "Stubs" or Birmingham gauge, and in this gauge No. 9 is .148 inch diameter, whereas, if he had carried out the terms of the order, he would have made the holes .194 inch diameter in accordance with "Stubs steel wire and drill gauge," the sizes of which are not given in the Brown & Sharpe catalogue and are not, in fact, readily found unless one happens to have at hand some of the cards or other publications of the Crescent Steel Company, whose polished drill rods are made to the same gauge.

It may be of interest to mention in this connection that none of these gauges is a legal standard in England. J. Bucknall Smith in his treatise on "Wire, its Manufacture and Uses," devotes a chapter to the gauge question. In this chapter he omits all mention of Stubs steel wire and drill gauge, though he mentions and gives the actual sizes of many others. In showing the confusion arising from the use of different gauges he says: "but the magnitude and importance of the question is far more forcibly demonstrated by Hughes' treatise of 1879, and in which the author displays no less than 55 different gauges, 45 of which were for measuring or determining the sizes of wire manufactured and sold within the United Kingdom."

Finally, to get rid of this complication another gauge differing from all the rest was invented and called the "Imperial standard wire gauge," and in 1883 the British Board of Trade notified the manufacturers that this gauge was the "only genuine," and it became the sole legal gauge in England in March, 1884. Notwithstanding all this it is needless to say that many of the old gauges continue to be used, and it is extremely doubtful if one half of the wire made in England is gauged by the "Imperial Standard," etc., gauge.

All this simply confirms the opinion of practically everybody who has investigated the matter of wire and sheet metal gauges, *i. e.*, that they should be done away with entirely, and the sizes of wire stated in decimals of an inch.

It is announced that the naval lieutenant who had charge of the work of inspection at Homestead during a large part of the time in which the frauds were perpetrated, has been superseded by Commander Frank Curtis, who has divided the corps of inspectors into day and night shifts, and will have them on duty at all times when the workmen are at work.

This we should suppose would add considerably to the difficulty of carrying on the fraudulent practices, but there was abundant evidence to show that some of the operations were carried on in the presence of the inspectors without their being any the wiser, and there is no getting around the fact that if an establishment really sets out to deceive inspectors, then those inspectors must be thoroughly familiar with every crook and turn of the business, and must be constantly on guard to prevent fraud. Whether the new chief inspector can accomplish much so long as his force of men must consist of young naval officers returned from voyages and temporarily assigned to shore duty is a problem. Plenty of men are employed in the navy who would be competent, or would soon learn to be efficient inspectors, but they are not in the right department of the service and it would be a frightful shock to naval sensibilities if a man in the engineer corps should inspect material for the ordnance department.

Some Recent Court Decisions.

It is fortunate, we think, not only for railroad employes and other workingmen, but for everybody interested in the preservation of American traditions and respect for law, that the United States Court of Appeals at Chicago has reversed the famous decision of Judge Jenkins which was founded upon the declared principle that there "could be no such thing as a lawful strike," and that men who merely agreed to quit work simultaneously, even where no intention of injuring or intimidating others was proven, were violators of law.

The most conservative journals of the country have, almost from the first, declared that this decision was entirely contrary to the spirit of American institutions and of American law, would amount to a serious infringement of personal liberty, prohibited by the Constitution, and could not be expected to be sustained by the higher courts.

The effect of the recent decision is, however, to prohibit strikes, unless they are absolutely peaceable, and all good citizens will approve this.

At the same time it has been decided by the courts that a locomotive engineer may not abandon his engine between stations to the serious injury of passengers or destruction of perishable goods. Whatever may be thought of the advisability or possible good to be derived from strikes, no one who thinks at all wants personal liberty to be infringed in order to prevent them, and it is certainly important not to strengthen the already too prevalent impression that the law and the courts are on the side of corporations. They should be on the side of nothing but good order and equal rights.

Soldering Aluminum.

A very recent, and perhaps one of the most important discoveries in relation to working aluminum, is that it can be readily soldered by first copper-plating the surfaces which are to be joined. It can then be soldered in the ordinary way, and with ordinary solder, and if afterward dipped in potash, the surplus solder, that is, that which is outside the joint, is cleaned off; and the process is said to be a complete success.

An accident occurred to a trolley car in Philadelphia the other day which shows the presence of a new danger incident to our present civilization. A motorman while on duty fainted and fell upon the platform of his car. The car then dashed on, collided with a cart and did considerable damage, besides inflicting injuries upon some of its passengers. Though in this case nothing very serious seems to have resulted, it is easy to see that, especially in a hilly town, the possibility of very serious accidents from such a cause is ever present, and it should be considered the duty of trolley companies to make all possible provision against it.

When the people forsake the older and slower means of moving about and demand that more powerful forces of nature be placed at their service, they must usually expect some added risk, but they are entitled to all the security that can in reason be given them.

Literary Notes.

DOWNING'S UNITED STATES CUSTOMS TARIFF.

We have received from R. F. Downing & Co., New York, a copy of their publication, which is intended especially for the convenience of those who wish to have at hand a ready reference to the customs tariff law. Besides containing the law verbatim as passed, the book mentions over 20,000 articles by their trade names, giving the proper rate of duty on each, with reference to the bill and to decisions by appraisers and courts. There is added, also, some useful tables of equivalent weights, measures, monetary units, etc., used in various countries. The book is 6¾"x4½", flexible covers, contains 532 pages and is sold at $1.

PROGRESS IN FLYING MACHINES. By O. Chanute, C. E.

This book treats of flying machines proper, that is to say, of forms of apparatus heavier than the air which they displace, deriving their support from and progressing through the air like birds by purely dynamical means. An endeavor has been made to explain the principles which govern flight, and to show the reasons for the failure of some machines. A full account is given of the recent experiments of scientists like Maxim, Lilienthal, Hargraves and Langley, who have done much towards the advancement of the knowledge of this subject. The author has gathered all the records of experiments, which were accessible, and these form the basis of discussion; they also show how much has been accomplished toward overcoming the various difficulties involved in constructing successful flying machines. It may be a surprise to many readers to learn of the advancement made towards success, and that the possibility of flying through the air is not an illusion.

The historical review of the experiments and results in this art is very interesting and will do much towards preventing future experimenters wasting time in trying devices which have already failed, and will also enable investigators to distinguish between inadequate and reasonable proposals.

The book is illustrated by nearly 100 engravings, and is written in a style which will be read with as much interest by the technical as by the non-technical reader. The book is published by the *American Engineer and Railroad Journal*, 47 Cedar street, New York. Price, $2.50.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(467) E. M., Brooklyn, N. Y., writes: Please give me the address of the parties who make hot pressed steel gears. *A.*—We do not know of any one who makes such gears.

(468) W. D., Zanesville, O., writes: Please inform me what ingredients are used with coal tar to make it non combustible and suitable for painting iron. *A.*—Coal tar and ground graphite, thinned with turpentine, make an excellent paint for boiler fronts, etc.

(469) H. E., Paducah, Ky., asks: What per cent. larger should the low-pressure cylinder be than the high pressure cylinder of a compound engine? *A.*—The area of the low-pressure cylinder is generally from 3.25 to 4 times larger than that of the high-pressure cylinder.

(470) J. A. G., Philadelphia, Pa., writes: Please explain as fully as possible the details of bending tubing such as is used in the construction of bicycles. *A.*—Very little, if any tubing is now bent for this purpose. Flat pieces of steel of suitable size are bent to the required form in rolls made for the purpose.

(471) J. R. G., Chicago, Ill., writes: I have noticed in your columns a reference to Mekarski system of train traction by compressed air. Kindly inform me where I can obtain full information in regard to this system. *A.*—We know of no other way of getting this information than by writing to the General Omnibus Company of Paris.

(472) R. P., ——, writes: Please explain what die sinking is and where I can obtain books treating on this subject; also state where it is taught. *A.*—It is the art of engraving and cutting dies for stamping coins, medals, etc., for forging and for all purposes of shaping material to a given form by pressure. The art includes the processes of planing, turning, drilling, chipping, filing and hardening. We do not know of any books which treat on this subject. The best and only schools that we know of for learning die sinking are the shops in which such work is done.

(473) S. C. W., Lancaster, Pa., writes: I would like to know the force with which a weight of 185 pounds will strike, falling through a distance of 2 feet. Can I obtain any tables which will give the force of a blow struck by given weights falling through different distances? *A.*—The average force in pounds of the blow will depend on the time during which the weight is brought to rest, or on the distance through which the weight acts in being brought to rest. When either of these two quantities are known you can compute the average force of the blow by the formulæ given in answer to 220 in our issue of May 3d, current volume. We do not know of any tables which will give you the desired information.

(474) E. P. H., Montreal, Canada, writes: I have charge of one of the principal saw and planing mills in this city. Your answers have helped me out before, and, therefore, would like to have you answer the following: We dress lumber, principally pine, and at times make more shavings (that is in summer) than we can dispose of. Can you advise me of a machine or a method by which we can compress these shavings for storage, and then use them for fuel in winter? *A.*—We do not know of any presses made for this purpose. We should, however, advise you to write to manufacturers of wood working machinery; the addresses of some of these are given in our advertising columns.

(475) C. C., Brownsburg, Canada, writes: Please inform me of the methods of drilling glass and hardened steel. *A.*—For drilling glass put a piece of brass tubing in the drill press spindle, the outside of the tube being equal to the size of the hole which is to be drilled; revolve rapidly and feed with emery and water. For thin glass the following method may answer your purpose: Stick a piece of stiff clay or putty on the part where you wish to make the hole. Make a hole in the putty equal in diameter to that of the desired hole in the glass, reaching the glass, of course. Into this hole pour a little molten lead, and the piece will immediately drop out. For drilling hardened steel the first method given for glass is probably as good a one as you can use.

(476) C. R. W., Erie, Pa., writes: Kindly answer the following: 1. What is the best material to use for cleaning locomotive brass work? *A.*—See answer to Question 69 in our issue of February 8th, and answer to Question 416 in our issue of September 6th, current volume. 2. What can I use for pasting paper to wood, and paper to stone? *A.*—Common glue will hold paper to wood. For paper to stone take equal parts of asphalt and gutta percha, melt them together, and use hot. Care should be taken to have the surfaces, which are to be joined, perfectly clean and dry. 3. What is used for blacking the smoke boxes on locomotives? *A.*—Use Dixon's graphite paint. Your other questions are out of our line.

(477) B. D. C., Allegheny, Pa., writes: Please give the title of a good book treating on the design of hydraulic machinery such as heavy punching and shearing machinery, cranes, accumulators, intensifiers, etc. *A.*—"The Mechanics of Hoisting Machinery," by J. Weisbach, is a good book. It treats on cranes, hydraulic hoist, accumulators, and hoisting machinery in general. We do not know of any book treating on hydraulic punching and shearing machinery. 2. Where can I find information on the manufacture of steam and water pipes, giving the description of the machinery and furnaces used, their construction, and their proper relative location in works of this kind? *A.*—We have not seen a book treating on this subject.

(478) P. W. T., Pittsburg, Texas, writes: Kindly inform me how much power will be required to run a tug boat up and down a stream towing three boats, each 30 feet by 12 feet, loaded. The current of the stream is 7 miles per hour. *A.*—Your question is very indefinite; the best we can do is to give a rough estimate only; you will require from 125 to 150 horse power. 2. How large should the water wheel be, and how many revolutions should it make? Can the rods be in front as well as in the back of the wheel? *A.*—From the tenor of your questions, we presume that you refer to a stern wheel. This should be about 14 feet diameter, and make about 24 revolutions per minute. As far as the working of the engine is concerned, the rods may be connected at the front or back of the wheel.

(479) C E. J., Bridgeport, Conn., writes: Kindly inform me if pens have ever been patented, and are they now? *A.*—Steel pens have been patented, but we do not know if any of them are patented now. Any patent attorney can give you all the particulars. 2. What is the average salary which draftsmen receive in the Patent Office, and have they to pass an examination; if so, what is the character of the examination? *A.*—We do not know what the average salary is, and we are not certain as to the examination, but we are inclined to believe that applicants will have to pass an examination. You can get the desired information by writing to the Commissioner of Patents, Washington, D. C. 3. Are there any drawings of machinery published from which I can copy, if so, from whom can I obtain them? *A.*—Yes: you can obtain them from publishers of scientific or mechanical works.

(480) D., Providence, R I., asks: 1. Is the Stubs wire gauge, "Birmingham standard," a general standard for all kinds of wire, whether steel, brass or iron? *A.*—It is generally so regarded, and unless there is something to indicate to the contrary, it is the gauge used for wire of any kind. 2. Should the designation, "Stubs *steel* wire gauge," be taken as referring to the special gauge generally used for twist drills and steel wire, no size being specified? *A.*—Yes. 3 A. orders a piece of work from B., with a hole "No. 9 Stubs steel wire gauge." B. fills the order, making the hole .148 inch diameter. A. returns the work for correction, claiming the hole, as per order, should be .196 inch diameter. Which is right? *A.*—We should say that neither was right. The gauge to be understood in this case is a special gauge made by Stubs for gauging wire drill rods and twist drills, and No. 9 by this gauge is .194 inch diameter. The incident simply again illustrates the fact that the "principal objection to the wire gauge is its existence," and that the whole business of gauging wire by fixed gauges and by numbers is wrong and should be abolished.

(481) C., Coxsackie, New York, writes: I have had some trouble in hardening my taps and dies, and getting them to the right color. Please inform me how this is usually done by the tool makers. *A.*—We assume from the language of your question that you know what the right color of taps and dies is, but that you have difficulty in securing this color, and we can only say that this is and must be a matter of practice largely, and the best method to pursue will depend much upon circumstances. Some tool smiths simply hold such work over a clear flame in the forge until it is sufficiently heated, others heat a suitably formed piece of iron which may be a plate in the case of a die, or a ring in the case of a tap. The die may be laid upon the hot plate and watched until the proper color appears. With the tap it is simply held with the tongs in a central position within the ring, the radiated heat in this case doing the work. 2. Please inform me why there are not more boilers made of the type used on the naphtha launches; they raise steam rapidly and are simple to make, provided the coils have been bent at shops where such work is done. *A.*—These boilers are patented, and can be made by those only who have a right to make them. Besides, there are manufacturers of other patented boilers, who claim that their type is the best. 3. What size of grate surface, diameter and length of stand pipe, and number and length of coils will be needed for a boiler of this type to drive a 2 horse-power engine? *A.*—Diameter of grate surface 27 inches; diameter of stand pipe about 4 inches. For the other dimensions you will have to make a drawing so as to determine the number of coils which can be placed over the given grate area. The length of the coils and stand pipe should be such that they will expose a total heating surface of about 120 square feet.

(482) W., Deadwood, S D., writes: I am using feed water of which the following is an analysis:

	Grains per gallon
Silica	594
Carbonate of lime	5.652
Oxide of iron and aluminum	.028
Carbonate of magnesia	3.825
Sulphate of lime	.811
Sodium and potassium chlorides	.188
Sodium and potassium carbonates	5.899
	16 997

I have been feeding by the drop through the feed water 1 quart of coal oil per 100 horse-power, and have also given 5 pound doses of caustic soda once a month, two days before blowing off the boiler, but still I find a very hard tenacious scale about $\frac{1}{16}$ inch thick stuck to the plates very fast. Please inform me if oak bark will help to remove the scale; or if there is anything better please name it. *A.*—We should introduce the quantity of kerosene which you have been using at one time, and blow the water down to two gauges every week, and the entire contents every month. When kerosene is used the glass tubes should be packed with asbestos wicking dipped in boiled oil and then squeezed dry. In using caustic soda you should blow off frequently, and not wait two days before blowing off. Oak bark may help you, but it must be used carefully. The tannic acid decomposes the lime salts and forms tannate of lime, which is insoluble at first, and forms a scum which should be removed by surface blowing. In regard to this R. Wilson in his treatise on steam boilersays: "Where tannic acid is found to work well, perhaps the best mode of supplying it is to suspend in the boiler a log of oak wood with the bark on, from which the acid is gradually extracted. In all cases where tannic acid is used its effect on the plates and tubes should be carefully watched."

(483) A. J. W., Hoboken, N. J., writes: I have seen the following statement in print: "Since one ordinary turbine wheel has the power of 150 men and one unit of machine power is equal to that of 4.4 horses, etc." In regard to the above I would ask: 1. Can it be said that an *ordinary* turbine wheel has a *definite* power without knowing the head of water? *A.*—No, even with the head of water given the power cannot be stated without knowing the size and type of wheel, which the word "ordinary" does not give. 2. Is there such a term known as the "unit of machine power?" *A.*—No. 3. Do competent engineers use such expressions? *A.*—No. We may add that such expressions as "the power of 150 men," or "of 4.4 horses," are, in engineering practice, meaningless, and consequently worthless. Men and horses, it is true, can perform work, but since all men or horses have not the same strength to perform work, the question at once arises, how much work can they perform? Again, there is quite a difference between the terms *work* and *power*. A force is said to perform work when it overcomes a resistance. Any kind of work may be assimilated to that of raising a weight, as in lifting a bucket of water from a well. In this case it is obvious that the work performed varies conjointly as the weight raised, and as the height through which it is raised. Denoting the weight in pounds by W and the height in feet by h, we have for the measure of work performed $W \times h$. The unit of work is called a "foot-pound," it is the work required to raise a weight of *one pound* through the height of one *foot*. For instance, the work required to raise 10 pounds through a distance of 6 feet is equal to 60 foot-pounds. Power, on the other hand, is the rate at which work is done, and the rate of work is the number of units of work performed in a given time. In mechanism this rate is usually expressed in terms of a horse-power, which is technically assumed to be 33 000 foot-pounds per minute, or 550 foot pounds per second. From this it will be seen, that in speaking of power, the element of time is of great importance and cannot be neglected, as has been evidently done in the statement to which you refer. A. Jamieson, in his book treating of applied mechanics, says: "The horse power unit was introduced by James Watt, the great improver of the steam engine, for the purpose of reckoning the power developed by his engine. He had ascertained by experiment that an average cart horse could develop 22,000 pounds of work per minute, and being anxious to give good value to the purchasers of his engines added 50 per cent. to this amount, thus obtaining (22,000 + 11,000) the 33,000 foot-pounds per minute unit, by which the power of steam and other engines has ever since been estimated." From this we may conclude that the expression, "one unit of machine power is equal to 4.4 horses," is indefinite, useless and nonsensical.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gears, Lex'n, Phila., Cleve'd. See page 12.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Turret Drills, 6 spindles. A. D. Quint, Hartford, Ct.

"National" Lathe Chucks. Best made, page 15.

Fine pat. work. H. Cooper, 118 William St., N. Y. C.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 157 William St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N. Y.

Best Presses and Dies for all sheet metal work, Ferracute Machine Company, Bridgeton, N. J.

Air Compressors for every possible duty. Clayton Air Compressor Works, 26 Cortlandt street, N. Y.

Match machines for sale, splint cutters, coilers & unloaders. I. L. Hawkins, bld'r, Waterbury, Conn.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

"Pumping Machinery." New book, 450 pp. 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton avenue, Philadelphia, Pa.

Model Locomotives. Complete sets castings N. Y. Central Standard up to date. Rough or finished. G. H. Olney, 163 Herkimer St., B'klyn., N. Y.

Gas manufactured continuously in any quantity or quality for heating and illuminating by the Bradley's direct gas generator. H. A. Bradley, 20 Nassau St., New York.

Emery, emery wheels, grinding machines and grinders' supplies, quick process and large stock. When in a hurry, buy of The Tanite Co., New York City, Cincinnati, Ohio, and Stroudsburg, Pa.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid. Published by John Wiley & Sons, 53 East Tenth street, New York.

"Modern Locomotive Construction." By J. G. A. Meyer. In this book the design and construction of all details of the locomotive and tender are considered from a practical standpoint. It contains illustrations of details made from working drawings, accompanied by plain directions for designing, and rules and tables for construction. Adapted to office and shop use. Price, $10. Published by John Wiley & Sons, 53 East Tenth street, New York.

Rustless Coatings for Iron and Steel. III.*

By M. P. WOOD, NEW YORK CITY.

TINNING AND ENAMELING METALS, LACQUERING, AND OTHER PRESERVATIVE METHODS.

The alloy of zinc, lead, antimony, arsenic, etc., with the tin used in the cans and vessels in which so large a quantity of our daily food is now marketed, is a serious menace to the public health. The most casual inspection of "the dump" that graces all our cities, towns, villages, hamlets, and even the solitary cottage beside the sea or 'neath the sheltering hill, can but convince one of the dangers we are daily exposed to from the cumulative poisons taken into our systems from this cause, and though we as a nation are wont to demur to the too close inspection of and interference in our so called private affairs, matters are so fast assuming a crisis stage from our greed for the almighty dollar, with the sentiment as a ruling passion: "No matter what happens so it does not happen to me," that relief and reform must be had, even if national, State, city, and town inspectors and Boards of Health one and all are called into being; happily if they could be divested of all political character; for the purpose of curtailing and controlling this growing cause of disease and death.

The terrors that lurk in the deadly tomato can is fast losing its joke and becom-

* Presented at the Montreal meeting of the American Society of Mechanical Engineers.

ing a sober reality. The benefits that arise from a careful inspection of the metal wares enclosing food products, even if the proceeding may partake too much of the paternal government character, is strikingly shown by the examination of the French articles so prepared, and a comparison of that tin ware with the best samples of English, German, and other continental countries, and noting its superior qualities, and how remarkably they resist corrosion or change from any of the vegetable acids in food, or to that due to fermentation. Our American tin plate manufacturers have much to learn in this matter, and may study French methods of manufacture with better results than those the imported Welshmen are striving to introduce.

One of the most trying situations for the protection of his work that the engineer has to deal with, is in the exposure of wrought or cast-iron water and gas pipes, through the cinder beds or fillings from blast furnaces, rolling mills, etc. Pitch compounds applied hot, afford some measure of protection over that of the naked iron, but the creep of the pipes due to changes in the temperature of the fluids passing through them, and of the surrounding earth, the concentrated action due to the sulphur in the cinder or ashes, the porous nature of the covering over the pipe and in which it is embedded allowing the ready access of air and moisture from the streets, ammonia and other fumes and liquids due to the decomposition of a score or more of different bodies, all aided by the vibration caused by the passage of heavy trucks, railway trains, and kindred causes, combine to render the problem one not easy of solution.

A thick puddle of good clay of a thickness all around of at least one-half the diameter of the pipe, and in case of pipes under 8 or 10 inches diameter, the thickness should be equal to the diameter of the pipe, if allowed to dry out well before covering in, gives a good protection and aids materially whatever compound is applied externally to the pipe. I do not know of any case where the pipes coated with magnetic oxide by the Bower-Barff or any other process has been tried, but it seems to the writer that if there was any situation in which the merit of the process could be demonstrated this is one, and it is not one of minor extent or importance.

The rapid destruction of the wrought and cast iron mains, as well as the galvanized iron and lead service pipes of our water and gas distribution systems, by electrosis brought into action by the use of the system of pipes as a ready ground connection for our extended and fast multiplying lines of electrical service, is assuming so serious an aspect, particularly upon streets or locations where electrical railways are in use, as to call for serious consideration by all branches of the engineering fraternity for some method of protection other than now in use.

So rapidly is the destruction progressing, that in many places the utter prostration of the water and gas systems may be looked for within the next decade. Pipes now affected, removed and replaced with new, but pass the corrosion further along to other and weaker points in the line, until the whole system is becoming honeycombed with points ready for failure on a little change in the ordinary working conditions.

The return current from the single wire trolley system of electrical car lines appears to seek out and take for its passage back to the power-house the pipe system contiguous to the line, instead of using the ground wire connections provided for it. The use of the electric motor now contributing so much to the comfort and conveniences of life in the form of electrically driven ventilators, pumps, elevators and other small powers is rapidly extending the evil. The remedy, if not provided by the electric light, heat and power companies in the form of taking better or sole care of their product from its generation to its extinguishment, will ere long be found in mulcting them for damages so heavy that the small margin now existing between the dividend point and a receiver will be wiped out.

Some experiments on a small scale of the Bower-Barff magnetic oxide application to pipes and iron exposed to electrosis action, appear to indicate its ample protective power. What it would develop upon an extended system of water or gas service remains to be tried. The iron pipes and connections, if protected by this process, would still leave the lead joints and lead service pipes exposed to attack. Cement joints might obviate part of the evil, but would render the main pipe line too rigid in withstanding changes of temperature, and expansion joints are not to be considered in pipe lines of hundreds of miles in extent.

The electrical engineers as a body appear to have given this question only a sort of a happy-go-lucky, or after me the deluge consideration; but the hour is not far distant when they will be walking the floor crying, "What shall we do?" instead of their water and gas brother who is now having his inning.

The protective power of lime-mortar and hydraulic cement to prevent corrosion in iron and steel under certain conditions has been demonstrated by centuries of actual use; yet the facts thus established are too often ignored by the engineer of to-day.

We do not have to turn back many pages of the record book of success and failure, to find a remarkable instance of the latter, in the utter collapse of the Bayliss patent wrought iron water pipe, that a few years ago was brought out as an indestructible, unperishable article with a hygienic annex, to take the place of cast iron pipe for water distribution.

The pipe in question was made of wrought iron from $\frac{1}{16}$ inch to $\frac{1}{8}$ or more inch in thickness, according to the size and pressure to which it was to be subjected; formed and riveted together in the shop or worked to shape upon the ground from the sheets, by a portable lot of rolls, punches and other tools needed, into sections about 5 feet or more in length; these sections being tapering, and if shipped were packed in nest form conveniently and cheaply so far as transportation was concerned.

The tapering sections were laid in the pipe trench and lined *in situ* with hydraulic mortar, the large end of the section forming the bell for the small or spigot end, the joint being made with the cement, and the outside of the pipe was also covered with the cement mortar to the depth of an inch or more, all as far as possible at one operation, depending somewhat upon the size of the pipe, the location and the general conditions of the work, setting of the mortar, etc.

The advantages claimed were a continuous pipe from end to end, no matter what its size or length, of uniform strength, lined with a non-corrosive and protective, tasteless and innoxious cement, and guarded from external injury and corrosion from acids in the soil in which it was laid, and atmospheric influences by the same or a similar cement covering.

The projectors wholly ignored the difference in the coefficients of elasticity between the iron and cement, depending upon the integrity of the lining to protect the iron from the water, this lining once broken admitted the water pressure to the iron, the thin riveted joints of which it was impossible to calk tight, the pressure thus reaching the external coating, which was unable to resist but a small head, cracked and flaked it off, and the destruction of the whole line of pipe followed rapidly, and, as a matter of course, after but a short period of service, most if not all of the lines being abandoned and relaid with cast-iron pipes inside of 10 years.

In general no attempt was made to coat the iron with zinc or any coating, or to remove the scale of manufacture. When the pipe was thrown out of the trench finally and broken up, the outside coating came away, bringing with it the scale and oxidation under it, as a porous plaster on removal takes away all over which it was spread. The connection of the house-service pipes with the main line gave no end of trouble to make and keep tight, and the whole system was a forcible illustration of the importance of those "next to nothings" that so often escape the attention of the best engineers, and bring no end of disappointment to those who are financially responsible for the introduction of the new idea.

Possibly the most extended application for a single purpose of the use of any process other than paint for the preservation of iron and steel exposed to atmospheric attack, has been made at Philadelphia, Pa., in the construction of the iron work of the tower of the new City Hall, now under process of erection and nearly completed. I am indebted to Mr. F. Schumann, C. E., president of the Tacony Iron and Metal Co., Tacony, Pa, contractor for the work, for the following data. The *Scientific American* also describes and illustrates the process in the following issues, the data for which was also furnished by Mr. Schumann:

October 22, 1892, Vol. LXVII., No. 17. Aluminum Electro-Plating in Architecture.

September 9, 1893, Vol. LXIX., No. 11. Electro-Plating with Copper.

This process is a double one. The first one is designed to protect the iron from rust by an electro-plating of copper of 14 ounces per square foot of surface, and a finishing coat of an alloy of aluminum and tin of $2\frac{1}{2}$ ounces per square foot, for color to harmonize with the stone work of the lower stories of the tower; also to prevent oxidation of the copper into a green coating of verdigris.

The process was adopted as a substitute for paint, the periodical renewals of which would cost $10,000 per annum, the primary coat of which was to be boiling linseed oil, in which all material was to be immersed until they had attained the temperature of the bath. The total weight of wrought and cast-iron to be protected is about 500 tons, and comprises 100,000 square feet of surface; the largest single pieces being 16 columns 27 feet long and 3 feet in diameter, weighing 10,000 pounds each. These columns received the copper coating inside as well as outside The outside coating, being most exposed, is a double one, requiring two operations or baths, while the aluminum coat is given last as the protective coating to all beneath it. The cost of the whole process varies from 40 cents per square foot to $1, depending upon the shape of the piece—simple plates, rods, angles, etc., costing the least, while curved pieces, with large lugs, flanges, with core holes, cost the most, the principal expense being the cleaning, the *greatest care* being necessary to insure good work.

The capacity of the Tacony plant is about 250 square feet per 24 hours of from 12 to 16 ounces per square foot coating; though some recent improvements by Mr. J. D. Darling, manager of the plating works, has nearly doubled the capacity of the plant, and avoids the trouble from "spit holes," blow holes and stodgy places, that give a great deal of trouble to search out and *solder up*. The electro plating covering, in these cases, evidently follows the peculiarities of galvanizing, where the smallest needle hole will be coated, but will not fill up the crevice.

The manipulation to apply the process necessarily varies with the shape and size of the piece. Suitable cranes, trolleys, hoisting gear, trucks, etc., being provided to handle one of the large columns referred to, the operation of coating it is as follows:

The column is first immersed in a tank containing a strong solution of caustic soda, heated by a steam coil, and is boiled a number of hours to remove all the grease and oil due to the machining process. It is then removed and thoroughly washed in water from a hose, then placed in a second tank and pickled with diluted sulphuric acid until all rust and scale are dissolved and loosened, then thoroughly cleaned with steel brushes and water and goes to the third tank containing the cyanide plating solution, and receives its first coating of copper. It is then removed from the bath and transferred to another tank and given a coating of paraffine wax *inside*, thence to the fourth tank containing an ordinary copper-plating solution, where it receives a heavy coating of copper, about 16 ounces to the square foot of surface. The paraffine is then boiled off and the column enters the sixth or aluminum tank and receives a heavy deposit of aluminum, 2 to 3 ounces per square foot. It is then well washed with pure water and is ready for erection.

The columns and other pieces are brought into the electric circuit by wires passing around them like slings, and attached to a conducting brass bar over the tank.

In the cyanide tank a current density of three amperes per square foot is employed; in the acid tank, ten amperes, and in the aluminum tank eight amperes. Separate dynamos for the several tanks are necessary, the developments being 1,000 amperes at 6 volts, 2,000 amperes at 8 volts, and 4,000 at $2\frac{1}{2}$ volts.

Mr. Darling's improvements in the acid solutions enable copper to be deposited at the rate of 20 to 25 ounces per square foot in 24 hours, that is as malleable and almost as smooth as rolled copper; and copper deposits one-eighth of an inch thick, or 10 pounds per square foot, have been made in 24 hours.

For rolled sheet iron and steel, and in rods and shapes where the surface is free from sand holes, 8 to 10 ounces of copper per square foot of surface will be sufficient, while on rough cast-iron or steel work 14 to 16 ounces will be required.

These amounts are greatly in excess of those given in books treating on electro-plating, but practical experience shows that the above amounts are necessary to give a protection that will prevent any appearance of rust, and will last as long as the structure will stand.

For inside work, when the plating is used more for effect than as a protection, zinc, tin or aluminum is added to the copper bath to give a bronze appearance, and a coat of 2 or 3 ounces to the square foot will suffice.

The new Bourse building, to be erected in Philadelphia, will have examples of both kinds of plating. The outside iron work, window-frames, etc., will have a heavy protective coat of copper, while the inside work will be electro bronzed.

In France, when copper-plating to protect iron was first used, the copper was not deposited directly on the iron, but on a coating of varnish, rendered conducting with plumbago or powdered copper, applied to the iron surface and allowed to dry. This was done to avoid the difficulties of cleaning the cast-iron and the use of two solutions in depositing the copper; as the article, after the varnish was dry and the plumbago applied, was placed directly in the acid solution.

This method gives a coating that is not firmly attached, and is liable to be torn off by mechanical injury. The lamp posts of Paris and the beautiful fountains of the Place de la Concorde and the Place Louvois are examples of this method.

The method used in America deposits the copper directly on the iron, and the article so plated may be bent and twisted into any shape without detaching the copper deposit. As it is often asserted that aluminum cannot be deposited from an aqueous solution, the following information, furnished by Mr. Darling, may prove of interest:

"Although aluminum is generally credited with indestructible qualities, and high resistance to corrosion, it has but few qualities that would make it advantageous as an electro deposit upon other metals; for while in a massive state it resists atmospheric action and retains a certain brightness for a long time, when it is deposited electrically from an aqueous solution, which deposit is of necessity of a more or less porous nature, it soon tarnishes and assumes a dull, bluish-white color, when exposed to the direct action of the elements. But for a protective coat, say for copper for which use it is used on the City Hall tower, it answers very well, as the slight superficial oxidation that takes place, protects the metal underneath from further attack, and the neutral color that it assumes

harmonizes well with the stone work of the tower. Aluminum is, no doubt, more difficult to deposit than any other of the common metals. This is because of the high voltage necessary to decompose aqueous aluminum solutions, and the tendency to redissolve after being deposited. We have not got the thermal data required to calculate the potential difference or electro motive force necessary to decompose the different aqueous solutions of aluminum, but reasoning from analogy, it must be several volts in each case, and as water requires only a minimum electro-motive force of 1.5 volts to decompose it, it would seem at first glance that a compound which requires over two volts for its decomposition in aqueous solution would involve the decomposition of the water, and therefore would be impossible. But in reality this is not so, as may be seen in the case of the caustic soda, which requires over two volts. Yet sodium may be obtained by its electrosis if mercury be present to absorb it and protect it from the water. The fact is, that when two substances are present requiring different E. M. F. to compose them, if the E. M. F. is high enough to decom ose the higher compound, the current is divided between them in some ratio decomposing them both, and I find by using a solution of aluminum that has but a slight dissolving effect on aluminum, with a density of current of eight amperes to the square foot, with a sufficient high voltage (6½ to 7·, aluminum can be deposited on the cathode at the rate of one gramme per hour per square foot, in a reguline state, and with higher currents it can be deposited much quicker, but it will be in a pulverulent state which does not adhere."

Recent improvements in this process form the basis of a patent for a proposed use of electro-copper plating for the protection of ships' bottoms applied quickly and cheaply in sections, by means of movable and portable baths, the deposits overlapping each other, the entire hull being thus treated during construction, or it may be applied to vessels already built. How effectual this application for the purpose named may prove is a matter of some doubt, owing to the difficulty of thoroughly cleaning the surfaces to be coated and which appears to be an indispensable condition for success.

The irregular contour of the immersed parts of the ship being plated *in situ*, as well as the porous nature of the copper deposit requiring a heavier coating than is absolutely necessary for protection, and whether some insulating or protective compound interposed between the copper and the metal of the ship will be required to prevent electrical action, all are questions to be settled by the slow test of time, which does so much to upset the best laid plans of mice and men.

If effectual, the cost of application at even the highest price named by the Tacony people, $1 per square foot of surface, would be small hindrance to its general adoption, it requiring only about $80,000 to coat our largest war vessel on its inside surfaces as well as the outside surfaces, joints in the armor, and all places not of ready access for the application of paint compounds.

JAPANESE LACQUER.

The adaptableness of this natural vegetable product to the preservation of metallic surfaces, as well as those of wood, paper, and other fibrous bodies, has never received the attention of engineers that the industrial importance of this method of coating and protecting surfaces demands. The general idea that its application is one of art, and is only adaptable to bric-a-brac, is wholly erroneous. The Japanese use it for an infinite variety of purposes—acid tanks, coating the keels of ships, highly finished coach and decorative panels, and articles for domestic use, resisting hot water, soap and alkaline solutions. It may be truly said that were it not for the bamboo and lacquer trees, life for the Japanese would hardly be worth living. There is no reason why the lacquer tree should not thrive in this country. Its sap, which is used as the material for all lacquer work, is a natural essence, and vastly superior to any varnishes used here. Unlike even copal, which is an artificial mixture of resin, fatty oils and turpentine, Japanese lacquer is a ready made product of nature that hardens into a mirror-like smoothness, never splits nor cracks, and is of great durability. The art-lacquer work of Japan is essentially individual, and ought not to be treated as an undistinguishable whole. The superiority of the art work is due not only to the special merit of the material, but also to the care and skill shown by the Japanese in the manipulation of it.

There is as wide a distinction between the ordinary lacquer tray, or cabinet of commerce, and the exquisite lacs of the great Japanese artists as between a theatrical poster and a canvas of Raphael. Each of the great masters of lacquer has created a style of his own, and has founded a school of which the traditions have been kept alive by his successors for centuries. At the Centennial Exhibition of 1876, in the Japanese department, there were exhibited plates, pans, etc., evidently of a common quality of lacquer used by sailors and others for domestic purposes; also some samples of a finer grade in trays and cabinet work that had been sunk in the sea over 50 years, and though covered with barnacles and other marine growths were practically unharmed so perfectly had they been protected by the lacquer. It seems almost incredible that so valuable an article that can be produced as cheaply as maple sap has remained comparatively unknown in this country and Europe, at least so far as applying it to the palpable protective purpose that nature evidently designed it to be used for.

In conclusion, the whole question of how best to protect iron and steel from corrosion in all the varying conditions that the wants and usages of to-day demand, seems to resolve itself into a category of Don'ts, as the best method of answering it, to wit:

Don't use anything but common iron.

Don't have any scale on that.

Don't use anything but the best iron and steel.

Don't polish those.

Don't paint it with anything but pure linseed oil and oxide of lead or graphite paints.

Don't let the air get to it if it is damp.

Don't keep it from the air if the air is pure and dry.

Don't let sea air, sea water, acidulated or sulphurous, ammonial or other fumes and liquids have access to it.

Don't think it unnecessary to protect it in any case, because swords, armor and other bright articles of iron and steel have been found uninjured by rust after an exposure of over 500 years with no other protection than that afforded by the closed room in which they were placed.

Don't think your own product would not under the same conditions last as long as the piece of iron that was walled into one of the burial chambers of the Pyramid, 3,000 years ago.

Don't put it into any location where it cannot be inspected and its true condition ascertained at any time, by anybody, your successor in the trust not excepted.

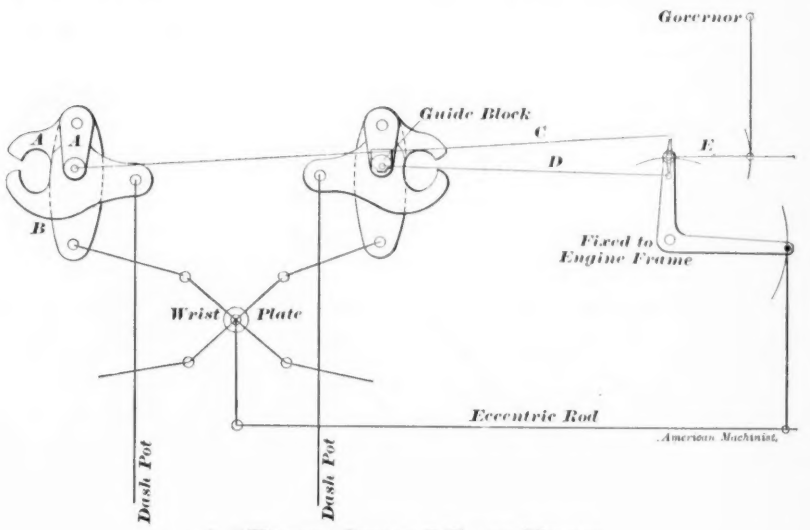
Don't think that magnetic oxide, electroplating, enameling or any other method of protection, will take the place of constant inspection, even if the coating is fired on by a Columbiad.

Don't imagine because Cleopatra's Needle has had to have a coating of wax to protect it, that it is not a good material to apply to other substances than granite.

Don't let the cost and interest accounts be the governing factors in the case of protecting any metal superstructure on whose continuity and strength human life and safety depend. The old story of "for want of a nail, the shoe was cast, the horse disabled, a battle and kingdom lost," finds too many parallels in the engineering practice of to-day, until in some cases we seem to need protection from the engineer quite as much as from the decay of the materials in which he experiments.

Don't imagine that Macaulay's New Zealander, who has sketched the ruins of England's power and greatness, and has come to the New World to see how we have fared from the gnawing teeth of time, will not recognize amidst the ruins of our Statue of Liberty, Brooklyn Bridge and other monuments of our progress, the ominous streaks and strains due to the corrosion not only of iron and steel, but that of the better class of metals, and will exclaim, "we are wiser in our generation and fear not and can control these forces that, like the Arch, slumber not, nor sleep."

NOTE.—*The Railroad and Engineering Journal* (Forney's), Volumes LXIV. and LXV., 1890 and 1891, has a series of articles on paint, its chemical nature, application, adulteration and other qualities as applied to *wooden structures*, by Prof. C. B. Dudley, chemist; and F. N. Pease, asst. chemist, Penn. R. R., Altoona, Penn. The papers are published exclusively by the above journal, beginning September, 1890, proper number 11 and follow monthly to September, 1891, number 22; and give the results of a long extended series of experiments on paint as applied to railway purposes, that are well worthy of perusal.



A "HYPHEN CORLISS" VALVE MOTION.

Antwerp Exposition.

BY C. W. CRAWFORD.

Whatever enjoyment may attend the majority of visitors to Europe this summer, it is certain the Exposition at Antwerp will afford the greatest satisfaction to engineers and mechanics. But coming so soon after that of Chicago it seems to be hardly appreciated at its real value; Americans especially are disposed to treat it with contempt. Although not equal to the Chicago Exposition in magnitude, and in architecture, it is quite equal to it in quality in most respects, and superior to it in the exhibits of other countries than ours. In manufactured goods almost every nation is represented. The Americans and English are among the smaller exhibitors in all lines, but very creditable as far as they go. The machinery department is quite large—probably one-third as large as that of Chicago in the machinery hall proper—and being chiefly foreign it is all the more interesting to us. Machine tools of the most excellent character are exhibited by several firms comprising almost everything used in an ordinary machine shop, and some special tools. Two American lathes, made by a Belgian firm, appear to be equal to those made here, and an open side screw planer by the same firm is a near approach to the American tool of that name. Shapers and milling machines closely resemble American tools, but the lathes are of a kind that an American machinist could do nothing with, unless he were born again. Machine tools, and for that matter all kinds of machinery is built heavier than ours as a rule, and everything is gotten up in the usual World's Fair style of finish. Several machines are fitted with bevel gears with curved teeth as an improvement on the double skew bevels used heretofore. This form admits of their being cut in a machine, and it is certainly a valuable improvement. In nearly all tools the European clamp tool holder is adhered to, but in all the shapers the tool holder is a square hole in the flap or apron, that admits of no adjustment of the tool whatever. Twist drills are coming to be more used, but some of them are yet made left-handed. The American monkey wrench is not to be found anywhere, nor any decent equivalent of it, nor anything to compare to our solid drop forged steel wrenches. Some of the same tools are exhibited that were at Chicago, among the rest the lot of milling machines and cutters, and the lathe for relieving milling cutters, by Reinecker, and also the general layout of tools by a Paris firm that will be remembered for their plain finish.

It is a rare thing to find an invention that is entirely new in any of these expositions, but such a one is found in the valve gear of two Corliss engines, by the Société Cockerill (systeme Frickart), of Seraing, Belgium. The improvement consists of a means of throwing the latches in and out by a motion which is hastened or retarded by the governor. The valve gear is made in the usual way, except that the latches, which are pivoted to the top end of the loose rocker arms, have each a small crank attached that extends down over the front of the gear to the center of the valve stems. From these cranks small rods extend back to near the governor where they are coupled together vertically by the short end of a T-shaped lever, the horizontal long arm of which is connected by a vertical swinging rod to the governor. The center of this T-lever is pivoted to the vertical arm of a bell crank lever, the center of which is fixed to the frame of the engine. The horizontal arm of this bell crank (which is the longest) is connected by a vertical swinging rod to the eccentric rod below, and from which it derives its motion. In operation the upper or vertical arm of the bell crank carries the T-lever back and forth bodily, and by the small rods also the two cranks and latches, giving the latches a grip of one inch or more at the proper time, and throwing them out early or late, according to the position of the T-lever which extends or withdraws the two rods in opposite directions, and by them also the latches, as the governor shifts the horizontal arm of the T-lever up and down. The valves are released by a positive motion, but the action on the governor, although it is in the same direction for each valve, is probably not greater than that of other Corliss engines. It works beautifully, and it has the merit of great durability. I was so much interested in this thing that I dared to make a little sketch and description of it, for which I got arrested, but after indulging a little Yankee bluff, I got off with the caution that visitors were not allowed to make any note of anything.

Four or five locomotives of excellent workmanship are exhibited; two of which have the front truck axle boxes placed in lateral circular grooves in the frames. These circles have their centers somewhere near the middle driving axle, and admit of the vibration of the front of the engine on the truck which consists of one pair of wheels only. In one of these engines the forward driving axle is 15 feet back from the buffer

beam, and 18 feet forward from the rear end of the cab. The object of this construction is to allow the engine to pass easily around curves. All of these engines have the Walschaert link motion, and at least one of them steam reverse gear. Two poppet valve engines of the "Sulzer" type, by a Belgian firm, several Corliss engines, besides those mentioned; one automatic slide valve with a tripping device; one poppet valve with a tripping device, having the valves in the cylinder heads working in line with the cylinder, and a medium size marine engine, by the Société Cockerill, are among the more attractive of the steam engines. Numerous gas and petroleum engines are on exhibition, all of good workmanship, but showing no new features, perhaps, that were not shown at Chicago. A large three-throw crank shaft for an Ostende & Dover steamboat, by the Société Cockerill, is exhibited. The shaft and crank-pin bearings are 20 or 21 inches diameter. The crank pins have each a hole 12 inches, and the shaft sections a hole 6½ inches diameter through the middle. The walls of the crank pins are only 4¼ inches thick, while those of the shaft are about 7 inches. I have always had the opinion that the shaft and crank pin ought to be the same size and strength, and I am surprised to find such a radical deviation by so prominent a firm.

Besides what I have enumerated, there is a great variety of other machinery, including a full paper mill plant, and an ice-making plant in operation. A full set of American shoe-making machinery is shown turning out excellent work; some American machine tools are exhibited by an English firm of machinery dealers, together with some English and some French tools. Some portable engines are exhibited, of the usual European construction.

Most of the Exposition buildings are temporary, but the main front and dome is an elegant permanent structure resembling that of the Paris Exposition of 1889. The attendance is about 30,000 daily.

Locomotive Engineering, for October, pays a worthy tribute of honor to engineer James Root, fireman J. E. McGowan, conductor Thomas Sullivan and porter J. W. Blair, all of whom on September 1st, at Hinckley, Minn., proved themselves heroes by saving the lives of passengers on their train, and many other people besides, under circumstances of the greatest difficulty and danger. During their frightful run of the gauntlet of fire, the heat was so intense that the cab windows were broken by it, and some of the glass cut Root so that from loss of blood and the heat he fainted and fell from his seat. McGowan then revived him by throwing cold water over him. Thus fighting their way, with coaches on fire, they reached a lake where the water afforded protection, and McGowan then uncoupled and saved the locomotive.

A testimonial fund, raised by admirers of Root and McGowan, in New York, was by their direction turned over to the fund for the relief of the sufferers by the fire.

Last week we mentioned the case of a young man who was killed by a stray current of electricity which passed through his body from an iron hand-rail which he grasped. A few days later a team of horses standing upon the iron cover of a sewer in Newark, N. J., were killed by another stray current, the source of which is at this writing unknown.

A special press dispatch from St. Louis says:

The case of Dr. Wellington Adams, who has been suing for infringement of patents all street-railway companies using electric motors, was dismissed in the Federal Court to-day. This kills the project for an electric line between St. Louis and Chicago.

It has for some time been thought that something would "kill the project." We had thought that the claims put forward by the projectors would suffice to kill it, and, in fact, they did kill it, only the projectors did not appear to be aware of its defunct condition.

Boiler explosions at sea are not common, but recently one of the boilers of the British steamer "Tanadico," plying between Mauritius and Bombay, exploded, killing four men, and injuring seven, and seriously disabling the vessel.

The Trades Union Congress at London has passed a resolution demanding that the Government prohibit the importation of destitute aliens; also to nationalize all mineral lands.

It is a fact so plain as to be very generally observed that the very best machine shops in this country like to interest their customers and others in their processes of doing work, "visitors always welcome," being their motto. It can be concluded, with enormous odds in favor of being right, that where visitors are rigorously excluded from a machine shop there is nothing inside worth seeing.

MANUFACTURES.

A water-works system is talked of for Bad Axe, Mich.

Millersburg, Pa., will have an electric lighting system.

The Coatesville (Pa.) Boiler Works will probably be enlarged.

San Diego, Cal., is to have an electric-lighting system at once.

An electric railway system will be established at Cortland, N. Y.

R. J. Hand may build a cotton seed oil mill at Muldoon, Tex.

An electric-lighting system will be put in at Lynchburg, Va.

An electric-lighting system will be established at Vicksburg, Miss.

An electric-light plant will be established at Germantown, O.

A $12 000 electric-light plant will be established at Gorham, N. H.

An electric-lighting system may be established at Meriden City, Mich.

A $75,000 electric-light plant will be erected at Jacksonville, Fla.

The Nesbitt (S. C.) Cotton-mill Company will build a $200,000 mill.

J. W. Spangenberg will establish an electric-light plant at Gatesville, Tex.

H. W. Hibsham will establish the manufacture of hosiery at Fremont, Pa.

An electric railway system will probably be established at Wellston, O.

The Gaffney (S. C.) Manufacturing Company will probably enlarge its plant.

B. F. Harwood will establish an electric lighting system at Uniontown, Ala

V. H. Vogle will probably establish an electric-light plant at Neosho, Mo.

A municipal electric-light system may be established at Centreville, Mich.

A well equipped electric-light plant will be constructed at Cardington, O.

The Columbus (Ga.) Railroad Company will erect a large electric power plant.

B. F. Harwood will establish the manufacture of cotton rope at Uniontown, Ala.

The South Jersey Traction Company will erect a power house at Bridgeton, N. J.

Steele & Co. are building a 50-foot four story addition to their mill at Bristol, Pa.

An electric-railway system will be established between Merced and Yosemite, Cal.

An electric light plant will be established at Otsego, Mich. B. A. Nevins is interested.

Dexter Lambert & Co. will probably rebuild their recently burned silk mill at Hawley, Pa.

It is reported that Worcester County capitalists will build a large woolen-mill at Millbury.

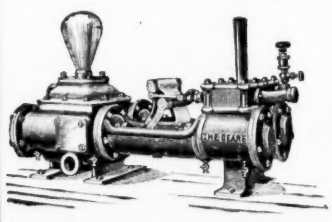
The city council of Gladwin, Mich., has passed an ordinance providing for an electric-light plant.

R. M. Oates, Jr., will increase the capacity of his hosiery-mill at Charlotte, N. C., about 50 per cent.

A plant for supplying electric light and power will be established at Wytheville, Va. A. E. Coulter is interested.

Better time is now being made at the plant of the Phœnix Iron Company, at Phœnixville, Pa., than for some time past.

The Southern Loom Harness and Reed Manufacturing Company is a new firm to manufacture loom harness at Spartanburg, S. C.



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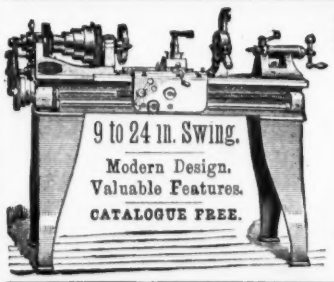
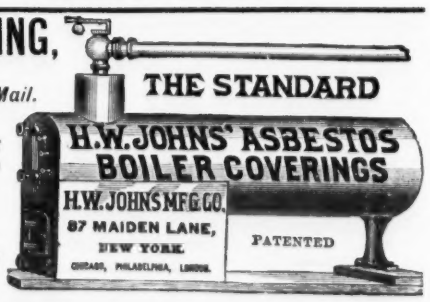
FOR BRASS FOUNDERS,
BOLLAND'S ENCYCLOPÆDIA OF FOUNDING,
12mo, cloth, - - - $3.00.
JOHN WILEY & SONS,
NEW YORK.



Speaking of LATHES!
We are building them in various sizes from 10 inch to 24 inch swing, in various lengths, both engine and speed lathes. Our designs are the latest and most approved, while the workmanship, material and finish are of the highest order. Our catalogue will tell you all about them, as well as of our planers, shapers, drills and other tools and supplies. A postal will bring it. Write us for prices.
SEBASTIAN LATHE CO.,
117-119 CULVERT ST., CINCINNATI, OHIO.

BORING AND TURNING MILLS
ARE SUPERIOR TO LATHES FOR FACE PLATE WORK.
We have a variety of sizes and a large stock for immediate shipment.
THE BULLARD MACHINE TOOL CO.,
E. P. BULLARD, Pres't. BRIDGEPORT, CONN.
New York Office, 86 LIBERTY STREET.

ASBESTOS CEMENT FELTING,
FOR LAGGING LOCOMOTIVE BOILERS.
Samples and Descriptive Price List Free by Mail.
We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.
H. W. JOHNS MANUFACTURING CO.,
87 Maiden Lane, NEW YORK.



The special committee at Morrisville, Vt., has purchased a water power at Cody's Falls, and will establish thereon an electric-lighting plant.

The Standard Oil Co. are building another oil refinery at Olean, N. Y., the brick walls of which are completed. These works will be used for refining Lima (Ohio) oil.

The Rand Drill Company, of Tarrytown, N. Y., has begun the erection of a foundry in connection with its other works. It will employ 200 more men when it is completed.

M. L. Andrew & Co., Cincinnati, Ohio, report a decided improvement in their business, manufacturing drill press spindles, wood-boring machine spindles, drill chucks and sockets.

The Lodge & Davis Machine Tool Co., of Cincinnati, O., have just received an order from the Union Drawn Steel Co., of Beaver Falls, Pa., for one of their improved shafting lathes.

The Quast Gas and Gasoline Engine Co. will build a machine shop at Bucyrus, Ohio, and will soon purchase an equipment of machine tools, wood-working machinery and foundry appliances.

The Stirling Boiler Company, of Chicago, have just closed a contract with the West Chicago Street Railway Company for 8,000 horse-power water-tube boilers, which aggregate nearly $100,000.

The recently burned Marshall hat factory at Pawtucket, R. I., will be rebuilt at once. The Marshall factory at Fall River, Mass., will be doubled in size and capacity in the approaching spring.

The Cleveland Twist Drill Co., Cleveland, O., write us: It seems to us that business is steadily improving. We are running our full complement of men ten hours per day, and have been doing so for some time.

The Lambert & Bishop wire mill, at Joliet, Ill., a branch of the Consolidated Steel and Wire Company, which has been closed since last July, started up about the tenth of September.

The Carrabus Cotton mill, of Concord, N. C., has increased its capital from $70,000 to $100,000. It is the firm's intention to erect a 50x189-foot two story building, to be equipped with 3,000 spindles and 30 looms. J. W. Burkhead is treasurer of the company.

Fletcher & Thomas, Indianapolis, Ind., recently shipped to Washington, D. C., one of their largest steam brick manufacturing plants, the purchasers being the brick and terra cotta works of that city. They also shipped a plant to Elwood.

Messrs. W. H. Holmes & Co., 226 La Salle street, Chicago, Ill., write us that the sales of their turret tool holder are increasing faster in the Southern States than in any other section of the country, indicating that the revival of business there is more decided than elsewhere.

The Stover Bicycle Factory at Freeport, Ill., is putting in a 40 horse-power boiler, and will make other improvements between this and spring. Next year the factory will be operated on a more extensive scale than ever, as the demand for the Stover wheel is constantly on the increase.

The Niagara Falls Power Company has filed with the Secretary of State a certificate of an increase of its capital from $2,600,000 to $3,000,000. The company is authorized to issue $10,000,000 in stock. The $400,000 increase is to be used in the work of extending the company's plant at Niagara Falls.

The McCoy Howe Company, Indianapolis, Ind., manufacturers of physicians' supplies and patent medicines, is erecting on West Georgia street, near Tennessee, a large three-story block constructed of brick and resting on a heavy stone foundation. When done it will be one of the most substantial buildings in the city.

The Pittsburgh Reduction Co., Pittsburgh, Pa. have opened a branch office at No. 4 Havemeyer Building, corner Church and Dey streets, New York. The office is in charge of Mr. James C. McGuire, the New York Agent and Consulting Engineer, and a stock of aluminum in various forms will be kept on hand there.

The mill department of the New Jersey Steel and Iron Works, Trenton, N. J., which has been shut down a long time, resumed operations on the 2d inst., about 500 hands being put to work. An official of the company said that he had no assurance of how long the mill would be kept running. The supply of orders was small, but there was enough on hand to keep several hundred men at work for several weeks. The company's mines at Ringwood and the furnaces at Durham have been opened with large forces.

The Indianapolis Harness Company, manufacturers of harness and saddlery, who, when running full-handed, employ about 100 people, have leased a building on East South street, in which they propose to manufacture the metal-seamed collar recently patented. The president of the company states that in the beginning they will employ about 25 men and expect to increase as the harness business demands. In the harness manufacturing department they are now working about 60 people, but business is improving and in a few weeks the company hopes to have its usual force at work. This company has a large Southern and Southwestern trade.—*Indianapolis Journal.*

Machinists' Supplies and Iron.

New York, October 6, 1894.

Iron—American Pig—We quote standard brands, $12.50 to $13 for No. 1; $11 to $12 for No. 2. Southern brands, $11.50 to $12 for No. 1; $11 to $11.25 for No. 2; $10.65 to $10.75 for No. 3; $11.15 to $11.25 for No. 1 soft; $10.90 to $11 for No. 2 soft. Foundry No. 4, $10 to $10.40.

Antimony—We quote L. X., 8.25c. to 8.32½c.; Cookson's, 9¼c. to 9¾c.; Hallett's, 7¾c. to 7½c.; and U. S. French Star, 9¼c. to 9½c.

Lard Oil—Prime City we quote at 67c.

Copper—The market is firm at 9.60c. for Lake Copper. Casting Copper is held at 9¼c. to 9⅜c. Some of the business was speculative, but it is claimed that consumers bought a considerable quantity.

Lead—The market is easier. Sales have been made at 3.12½c. to 3.15c., New York delivery.

Spelter—The market is easier at 3⅜c. to 3.40c. for New York delivery.

Tin—The market is more active, with an improved demand for spot and futures. For spot 15.95c. is quoted, and for futures, 15.55c. to 15.60c. is asked.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Machinist wants job in shop; young man, steady habits. Address Box 31, American Machinist.

Comp. draftsman, exp'd in eng., boilers and gen. mach'y, wants position, grad. Box 7, Am Mach

(*Continued on Page* 14)

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INSIST ON HAVING
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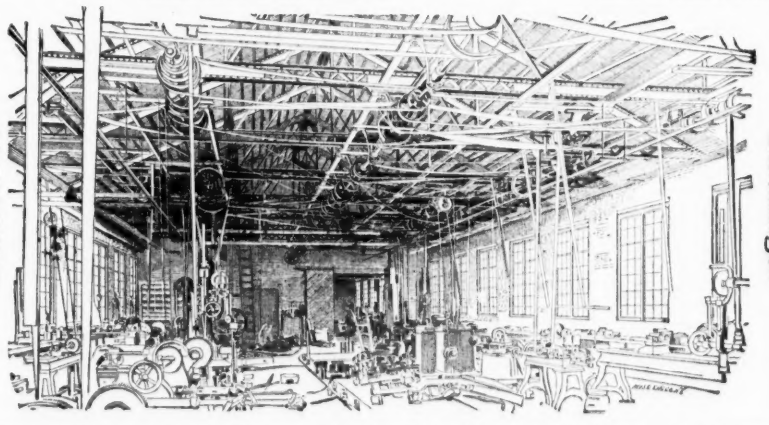
PROVIDENCE, R. I., U. S. A.
3000
VARIETIES FILES
[X. F.] & INCREMENT CUT FILES.

THE BERLIN IRON BRIDGE CO.
Office and Works,
No. 8 Railroad Ave., East Berlin, Conn.
CHAS. M. JARVIS, Pres. and Chief Engineer. BURR K. FIELD, Vice-President.
FRANK L. WILCOX, Treasurer. GEO. H. SAGE, Secretary.

Engineers, Architects and Builders of

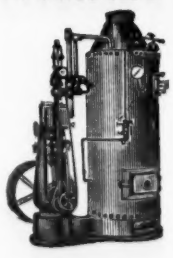


Iron and Steel Bridges and Buildings.

The above illustration is taken direct from a photograph, and shows the construction of an Iron Truss Roof designed and built by us for The C. W. Hunt Co., at West New Brighton, Staten Island, New York. The building is 42 feet in width by 202 feet in length, and is used by the C. W. Hunt Co. as a Machine Shop. The side walls are of brick and the roof trusses of iron, with iron purlins covered with slate, so that no wood work is used about the construction of the building in any way, shape or manner, thus eliminating entirely the danger from fire. This is one of the best designed and equipped Machine Shops of its size in the United States.

SEND FOR OUR ILLUSTRATED CATALOGUE.

COOKE & CO.,
163 & 165 WASHINGTON ST.,
NEW YORK.
ENGINES and BOILERS.



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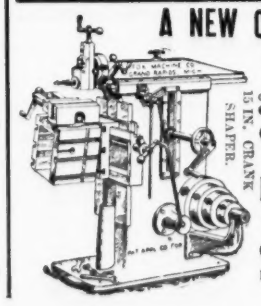
HORIZONTAL,
STATIONARY,
PORTABLE,
Plain and Automatic.
Write fo. Catalogue and mention this paper.

HENRY CAREY BAIRD & CO.,
INDUSTRIAL PUBLISHERS, BOOKSELLERS AND IMPORTERS,
810 Walnut St., Philadelphia.
Our New and Revised Catalogue of Practical and Scientific Books, 88 pages 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

A NEW CRANK SHAPER.



NOVEL, YET SIMPLE.
Length of stroke changed INSTANTANEOUSLY while IN MOTION.
Get Photos & Prices.
NOTHING LIKE IT.
Fox Machine Co.,
325 Nor. Front St.,
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135 Finsbury Pavement, London, England.

"Star" Foot Lathe Swings 9x25 in.
LATHE
Screw Cutting Automatic Cross Feed, etc.
Scroll Saws, Circular Saws, Lathes Mortisers.
Catalogue Free of all our Machinery.
Seneca Falls Mfg. Co., 687 Water St., Seneca Falls, N.Y.

JESSOP'S STEEL
FOR TOOLS, DRILLS, DIES, &c.
ALL KINDS IN STOCK.
Manufactory, SHEFFIELD, ENG.
Chief Am. Office, 91 JOHN ST., N. Y.
WM. JESSOP & SONS, LTD.
Established a century ago.
Medal World's Columbian Exposition 1893.

C. W. LE COUNT,
SOUTH NORWALK, CONN.
REDUCED PRICE OF LE COUNT'S HEAVY STEEL DOG

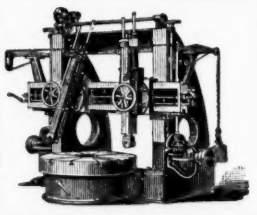
This Dog has a Very Heavy Boss, so that if the thread wears a Heavier Screw can be substituted.

No.	Inch.	Price.
1	3-8	$ .40
2	1-2	.50
3	5-8	.60
4	3-4	.60
5	7-8	.70
6	1	.70
7	1 1-8	.80
8	1 1-4	.80
9	1 3 8	.95
10	1 1-2	.95
11	1 3-4	1.10
12	2	1.20
13	2 1-4	1.35
14	2 1-2	1.45
15	3	1.60
16	3 1-2	1.80
17	4	2.10
18	4 1-2	2.75
19	5	3.25
Full set of 19		$21.60
20 (ext.)	5 1-2	4.00
21 (ext.)	6	5.09

When ordering, state as above, whether a full set or a set of 12, or small set of 8. Users of these dogs prefer them to any other make.

Le Count's Heavy Steel Dog.
With Steel Screws, Lathe Made and Hardened.

One Small Set of 8—by 1-4 inches to 20 inch, $6.25
One Set of 12—by 1-4 in. to 2 in. continued by 1-2 in. to 4 in. 13.25
These goods are for sale by CHAS. CHURCHILL & CO., L't'd, 21 Cross St., London, England.



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COMBINING EVERY IMPROVEMENT.
14 SIZES FROM 5 TO 20 FEET.
BETTS MACHINE COMPANY,
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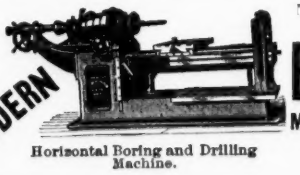
MANUFACTURERS OF
FITCHBURG AND OTHER MODERN METAL-WORKING MACHINES,



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THE CELEBRATED
ENGINE LATHE
SEND FOR CATALOGUE E.
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BUILDERS IRON FOUNDRY,
(Patented.)
PROVIDENCE, R. I.

GLOBE SPECIAL CASTINGS FOR WATER-WORKS, MILLS AND RAILROADS.
"I think they are the most practical special in use at the present time."
All common sizes in stock. Catalogue mailed on application.
M. J. DRUMMOND, Sales Agent, 192 Broadway, New York City.

P. H. & F. M. ROOTS,
Connersville, Indiana.
Chicago Office, 1405-10 Manhattan Building.
MANUFACTURERS OF
PORTABLE FORGES, TUYERE IRONS, ETC.

ROOTS' NEW ACME HAND BLOWERS
Slow speeded, Force-blast, Durable, Compact and Cheap.
Roots' Foundry Blowers, Gas Exhausters, etc.
S. S. TOWNSEND, Gen. Agt. COOKE & CO., Selling Agts. } 163 & 165 WASHINGTON ST., NEW YORK.
In Writing, Please Mention This Paper.

WORTHINGTON CONDENSER.
ONLY APPARATUS that can MAINTAIN a VACUUM on ENGINES and ELEVATE the discharge WATER to TANK at any height.
This feature is appreciated by PAPER MILLS, SUGAR REFINERIES, COTTON and WOOLEN MILLS.
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NEW YORK, 86 and 88 Liberty St.
BOSTON, 70 Kilby St.
PHILADELPHIA, 607 Arch St.
CLEVELAND, 24 South Water St.
CHICAGO, 185 to 189 Van Buren St.
ST. LOUIS, Eighth and St. Charles Sts.

Good draftsman and designer, grad. Poly. In. Germany, wants to change pos. J., Am. Mach.

Situation wanted by toolmaker in charge of automatic machinery. Box 33, Am. Machinist.

A mach. shop supt. of superior ability desires to make a change; cor'd'e solic'd. Box 25, Am. Mach.

Practical toolmaker wants situation; understands designing jigs and fixtures for interchangeable work. Box 26, American Machinist.

Wanted—Mechanical, electrical, civil engineers, draftsmen; professional work for spare time; liberal pay. Edwin Guthrie, Washington, D. C.

Open for engagm't, reliable party, expert in shop and office work, estimat'g, calculat'g, design'g and bldg. steam hydr. & gen. mach. of highest efficiency at least cost. Mech. Engr., 136 E. 40th St., N. Y.

Wanted—Molder to take charge of foundry. Must be thoroughly competent to make marine engine castings and propeller wheels. Phœnix Iron Works, Port Huron, Mich.

Wanted—A first-class man to take the foremanship of a gas engine factory. Applications must be accompanied by good references. Address Gas Engine Foreman, care American Machinist.

Wanted—A partner with $3,000, to take half interest in an established machine and repair shop; have several good patents; must be a practicable machinist, and capable of taking charge of shop. Address Partner, care American Machinist.

Wanted—An industrious and steady man with 10 to 15 years experience, to take charge of machine shop employing 40 men: must be well recommended. Also one good man for piping. Address Box 32, American Machinist.

Wanted—Position as superintendent by a mechanical engineer with years of experience, and an excellent record in the management of men and the economical production of fine work; references first-class. Address Enterprising, Am. Machinist.

As business manager of machine works. Wanted a first-class pos. by gentleman who is thoroughly practical in all the departments, able and reliable in business matters; 30 years exp., covering many lines of machinery; unexceptionable references. R. Wadsworth, 801 63d street., Englewood, Ill.

Wanted—A salesman who has handled the highest grades of English crucible steels through the New England States to introduce in that territory an American steel of equally high grade; only one who can command a trade of $100,000 per annum need apply. Address Box 20, Am. Machinist.

A bright, active man of 15 years' experience jobbing engines and machinery in Chicago and the West, wants to add to his line something of merit; knows the Western trade thoroughly; will handle goods on a strictly commission basis. Correspondence invited. Address Engineering, Room 130, Stewart Building, New York City.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Wanted—To buy good second-hand tools. Box 83, American Machinist.

Draftsmen's new conveniences for rapid work. Send for blue print. D. J. Kelsey, New Haven, Ct.

Every mechanic should have a copy of "Pocket Primer of the Air Brake." Sent to any address for 50 cents. W. S. Rogers, Buffalo, N. Y.

Wanted—To enter as partner or stockholder with owners of machine shop, to manufacture a new line of machinery. The outcome of experience; well tried; demand increasing; an excellent opportunity to right party. H., Am. Mach.

CLEVELAND TWIST DRILL CO'S. GRIP SOCKETS.

No More Twisted Tangs.

Larger drills can be used with smaller shanks than ever before. No charge for the groove in the shanks.

Send for Descriptive Price List.

Cor. Lake and Kirtland Sts., Cleveland, Ohio.

DETROIT TWIST DRILL CO., DETROIT, MICH., U. S. A.

SOLE MANUFACTURERS OF

GRAHAM'S GROOVED SHANK TWIST DRILLS AND CHUCKS.

Endorsed by Practical Mechanics Everywhere. Send for Catalogue.

Machine and Boiler Tools,

MODERN STYLE, AT LOW PRICES.

IRON PLANERS.

19 in. x 3 ft. Wheeler.
20 " x 6 " Pratt & Whitney.
22 " x 5 " Pease.
24 " x 4 " Wood & Light.
24 " x 5 " New Haven.
24 " x 6 " Wood & Light.
26 " x 7 " N. Y. S. Eng. Co.
27 " x 5 " Pond.
30 " x 10 " Bancroft heavy A1
36 " x 8 " Pease.
60 " x 24 " Steam Eng. Co.

SHAPERS.

16 in. Stroke Gould & Eber.
22 " " Triple Geared.

DRILLS.

3 Spindle Slate Sensitive.
3 Spindle Hendey.
20 in. Swing Wheel Feed.
20 " " Prentice, stand comp.
25 " " Prentice, complete.
40 " " Cinti, complete.
Radial Drill, 86 in., complete.

MILLING MACHINES.

Brown & Sharpe No. 6 Plain.
Brainerd Plain Table 30 x 8.
Brown & Sharpe No. 1 Universal.
Lincoln Pattern, very cheap.
Garvin, No 2 and 4.

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Bement No. 2 Hor., B. & D.
Bement Cyl. Borer, 12 to 36 in.
Upright B. & T. Mill, 38 in.
Brown & Sharpe Upright Turret Borer, takes in 36 x 12 in.

ENGINE LATHES.

13 in. x 6 ft. Blaisdell.
14 " x 6 " Reed Taper.
15 " x 5 " Pond.
15 " x 8 " Standard.
16 " x 6 " New Haven.
16 " x 6 " Ames.
16 " x 6 " Putnam.
20 " x 10 " Fitchburg
20 " x 12 " Prentiss Taper.
22 " x 8 " Harrington.
22 " x 10 " Putnam.
24 " x 12 " Putnam.
34 " x 8 " Putnam
35 " x 15 " Hewes & Phillips.
36 " x 24 " Old Style 'cheap.'
48 " x 17 " Hewes & Phillips.

HAMMERS.

50 lb. Helve, Bradley, Up g't.
800 " Steam, Ferris & Miles.

BOILER AND BRIDGE TOOLS.

Rolls, 7, 8 and 10 ft.
Hor. Flange Punch, "H and J."
Bement Plate Planer 16 ft.
Allen Pneu. Bridge Riveter with reach of 60 in.

MISCELLANEOUS.

Imp. Brass Cabinet Turret.
Acme, 1 in. Bolt Cutter with Dies, Nut Taps, Chuck, etc.
Slotters 10 and 18 in. Stroke
Stiles No 14 Adj. Press, weight 4,200 lbs. Good as new.
Screw Machine, 2 in. hole.
Screw Machine No 2. Wire feed

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SUCCESSOR TO
E. P. BULLARD'S
N. Y. Mach'y Warerooms.

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LAKEVIEW, WASHINGTON,

A model manufacturing location. Special inducements offered to manufacturers. Unexcelled facilities for coal and lumber, and shipment by rail and water. Eighty-ton Iron and Steel Rolling Mill (only one in the State) now being built. Address,

THE SOUTH TACOMA COMPANY,
P. O. Box 207. TACOMA, WASHINGTON.

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With Adjustable Parallel Ruler,
More Reliable Than The Old T-Square.

30x42 $30. 36x48 $35. 36x60 $40.

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BROOKLYN, N. Y.

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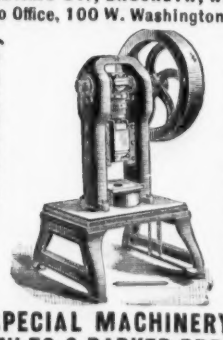
1 ADAMS ST., BROOKLYN, N. Y.
Chicago Office, 100 W. Washington Street.



PRESSES, PUNCHES, SHEARS, DIES, DROP HAMMERS,

SPECIAL MACHINERY.
The STILES & PARKER PRESS CO.

MACHINERY BARGAINS.

10 in. Post Drill.
10 " " Auto. Feed to Table, for Butt Drilling.
1, 2 and 3 Spindle Sensitive with and without Power Feed.
2, 3 and 4 Spindle Gang Drills
20 24, 26, 28, 30 and 44 in. "
60 in. Swing Post Drill.
5 ft. Arm Radial Drill.
12 in. Stroke, 16 in. x 16 in. Crank Planer.
16 in. x 4 ft. Planer.
24 " 4, 5 and 6 ft. Planer.
28 " 5 and 8 " "
30 " 5, 8 and 10 " "
60 " 20 " "
72 " 25 " "
9, 12, 16 24 and 26 in. Stroke Shaper.
10 in. Stroke Slotter.
Hyd. Rivetting Machine.
" Crane, Both A1.
Punch and Shear.
Plate Planer.
Hor. Flange Punch No. 2 H. & J. Thomson Bevelling Shear.
15 " 6 and 8 ft. Eng. Lathe.
16 " 5 6, 7 and 10 ft. Eng. "
18 " 6 7 and 8 " " "
20 " 5, 6, 7, 8 and 10 ft. " "
21 " 10 and 13½ ft. " "
24 " 10 " " "
25 " 16 and 24 " " "
32 " 16 " " "
52 " 35 " " "
57 in. Double Head Driving Wheel Lathe.
88 in. x 20 ft. Engine Lathe.
Bement Car Axle Lathe.
1¼ & 2 in. Bolt Cutter Schenk's.
7 Spd'l Nut Tapper, Dunel.
2 Spd'l Profiler, No. 1 P & W.
No. 1, 2 and 2½ Screw Machs. P. & W.
No. 1 Lincoln Pattern Miller.
Hand Millers, Screw Slotters, Mill and Cutter Grinders.
No. 2 Garvin Universal Miller.

Lot of Miscellaneous Machinery, Engines, etc. Send for Latest List.

GEO. PLACE MACHINE CO.,

Offices: 145 BROADWAY and 86 LIBERTY ST.
Warehouse: 511 and 513 WEST 13th STREET,
NEW YORK.

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TO BUY FOR CASH.

First-class Second-hand Engine Lathes, Planers, Drill Presses, Shapers, Milling Machines, etc., address,

The Fosdick & Plucker Machine Tool Co.,
CINCINNATI, OHIO.

Our Portable Forges completely take the place of old-style forges, take less room, run light and still, save time and fuel, wear a lifetime. Our foot-power emery grinders illustrated in this paper, save time and files, and we can save you money if you will mention this paper and write us.

Chapman Portable Forge Works,
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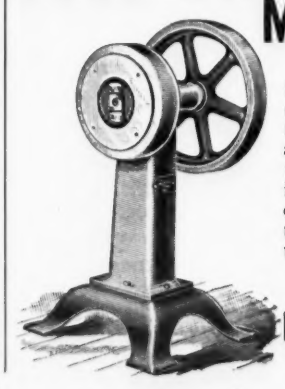

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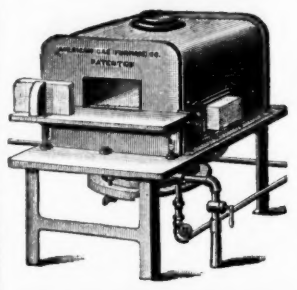

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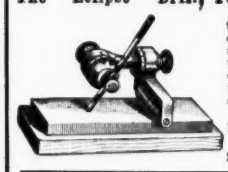

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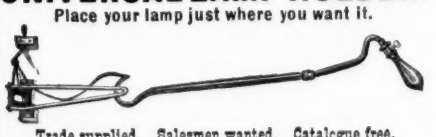

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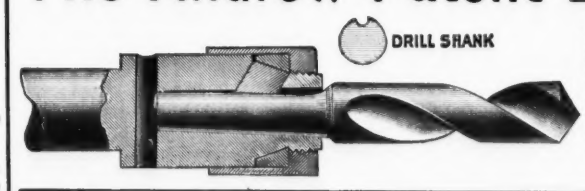

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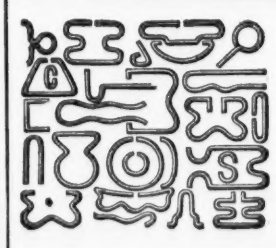

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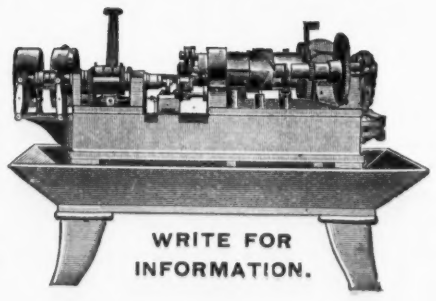

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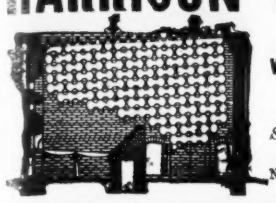

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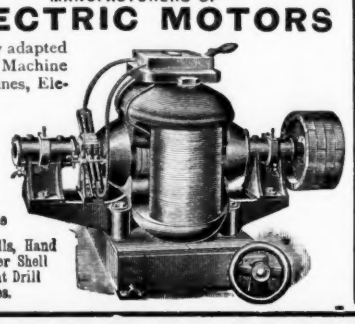

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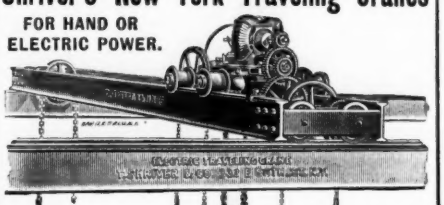

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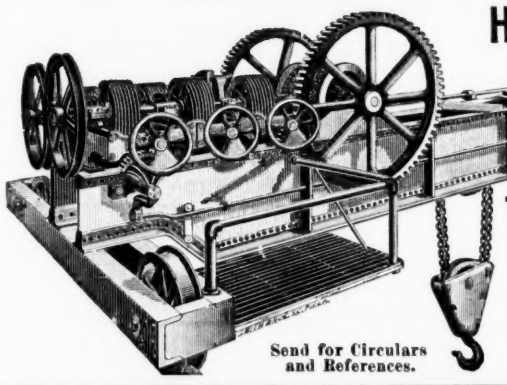

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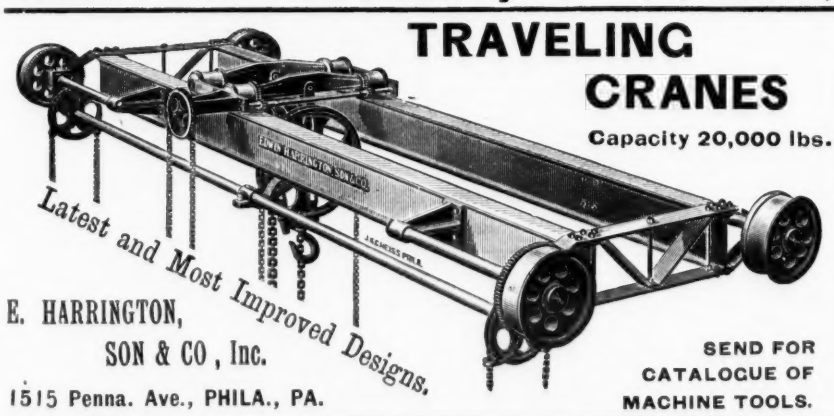

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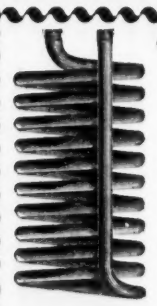

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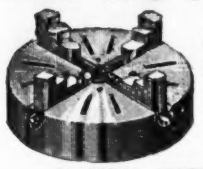

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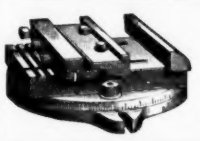

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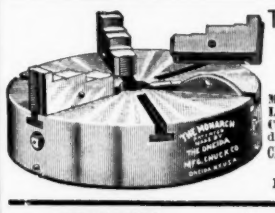

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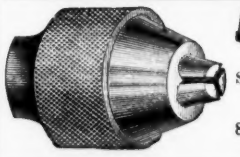

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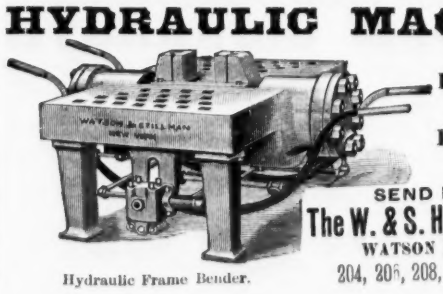

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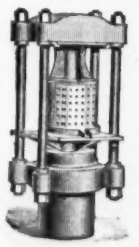

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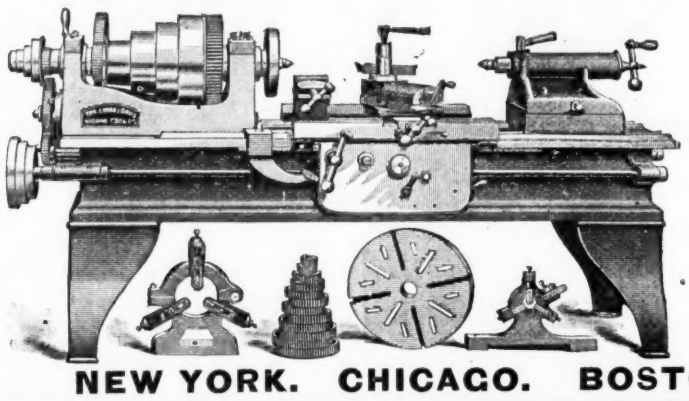

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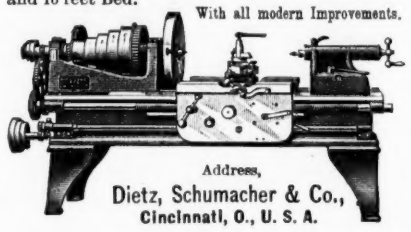

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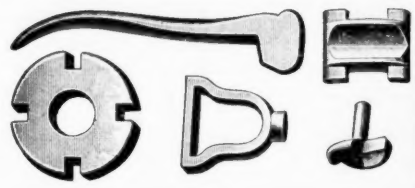

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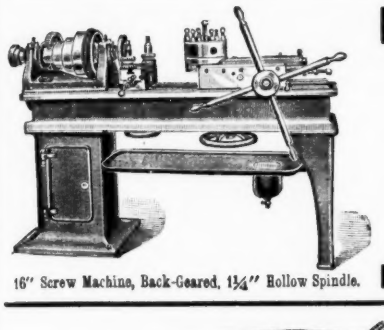

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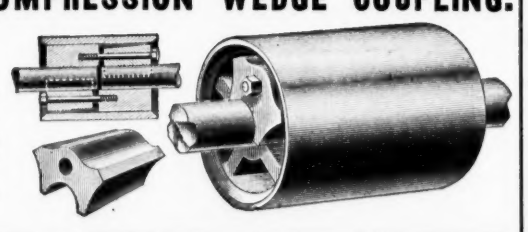

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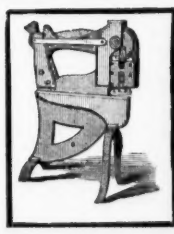

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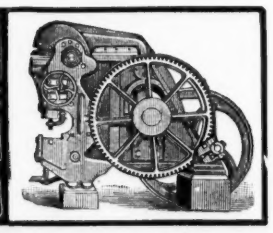

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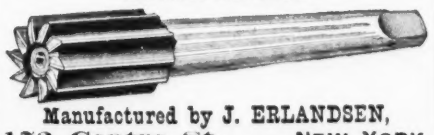

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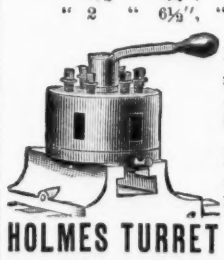

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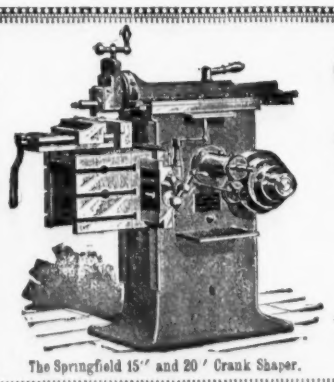

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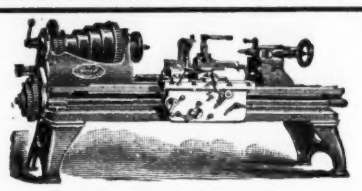

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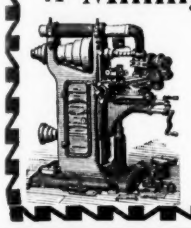

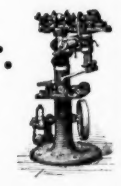

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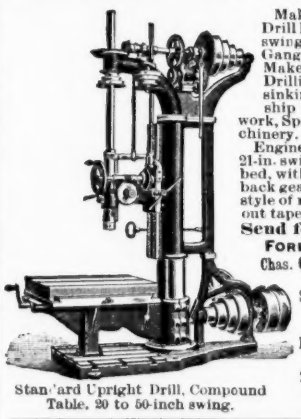

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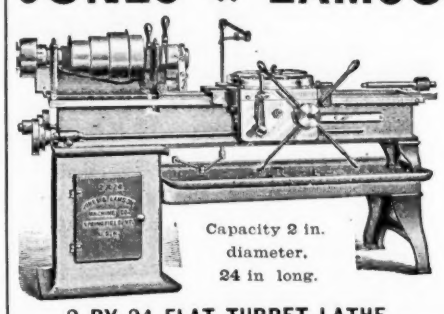

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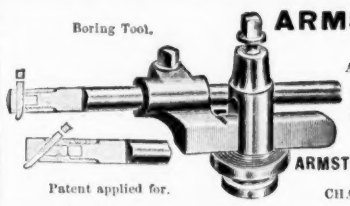

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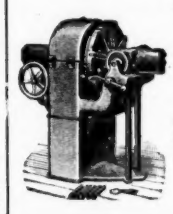

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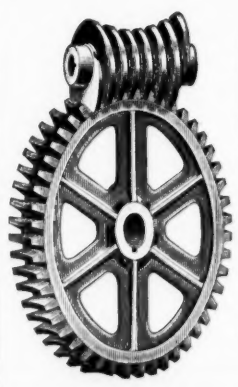

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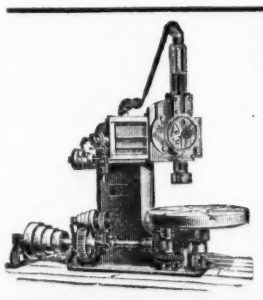

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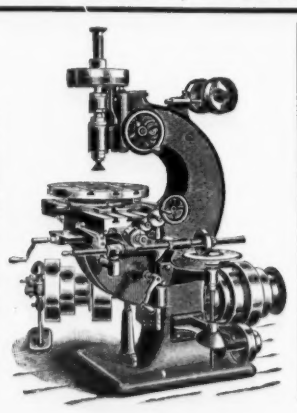

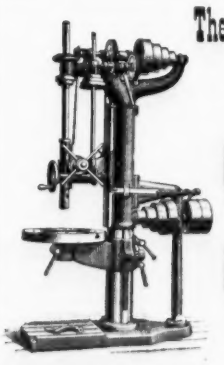

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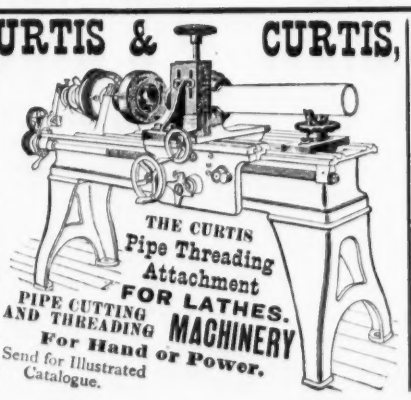

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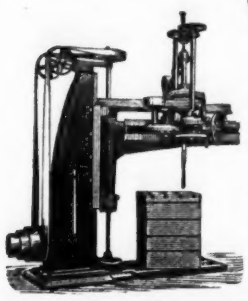

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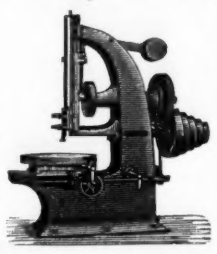

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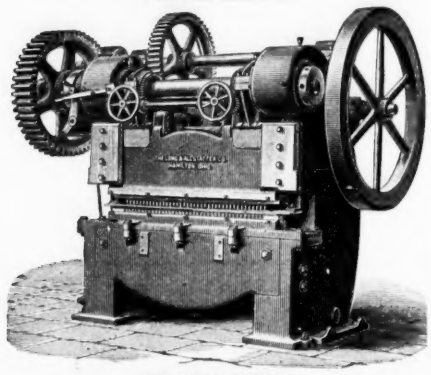

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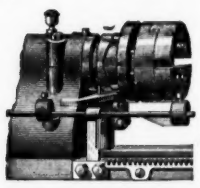

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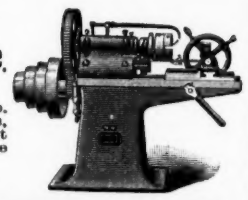

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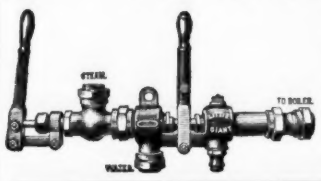

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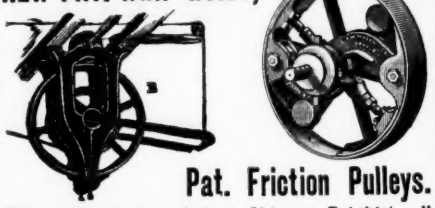

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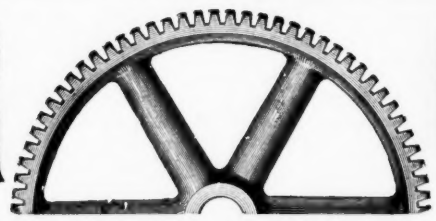

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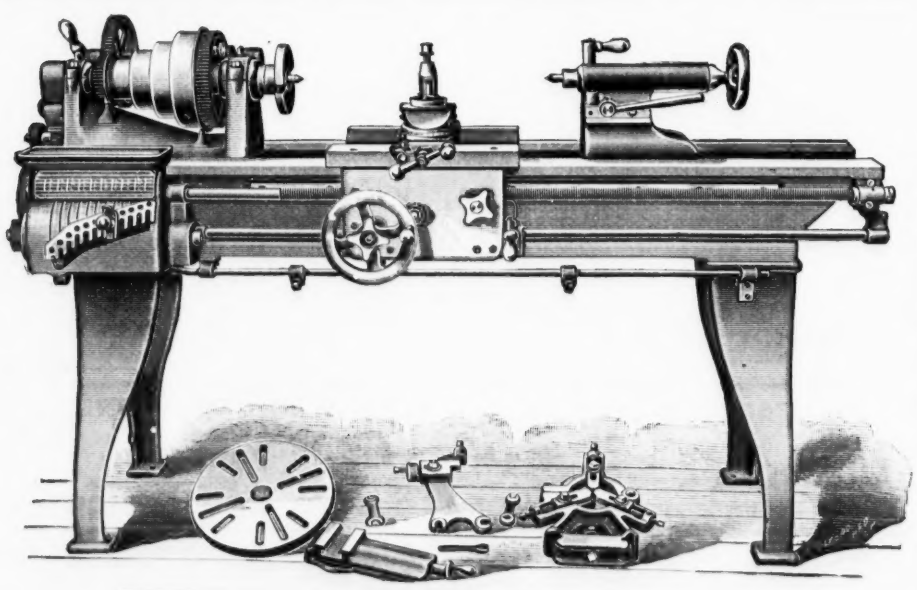

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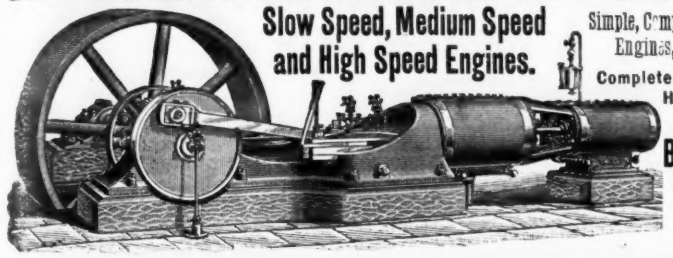

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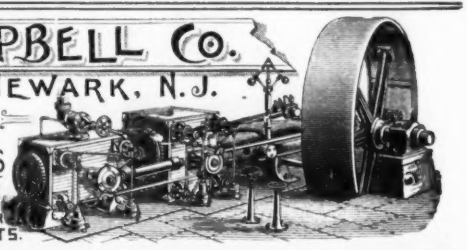

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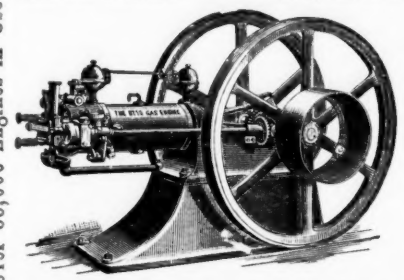

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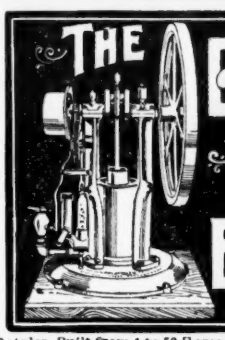

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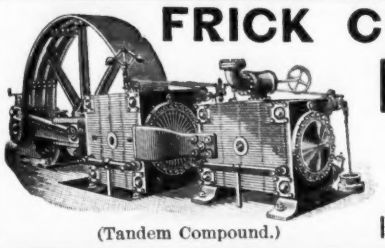

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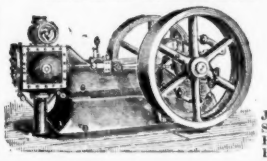

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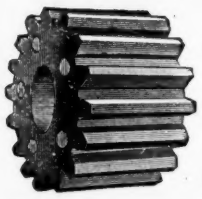

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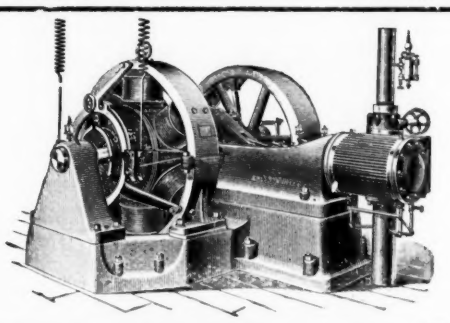

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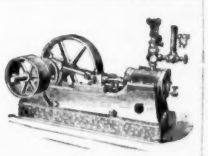

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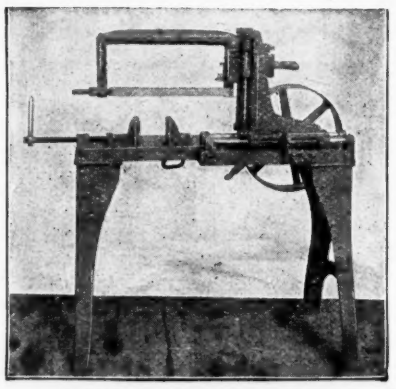

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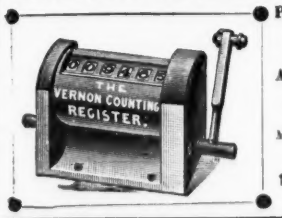

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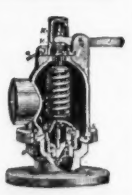

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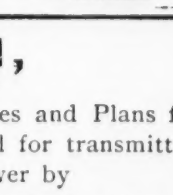

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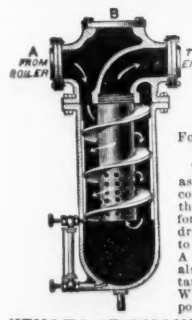

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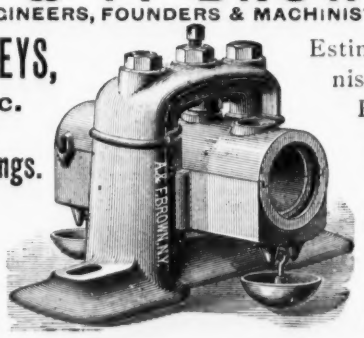

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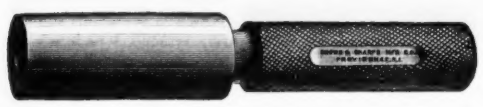

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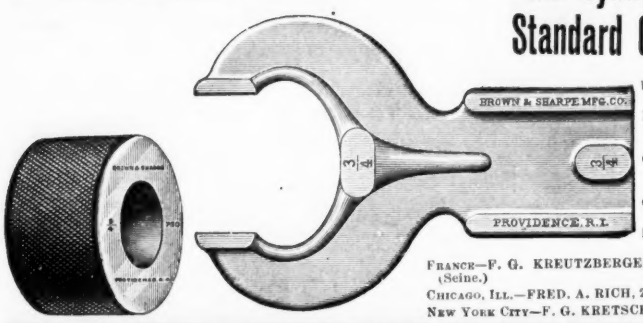

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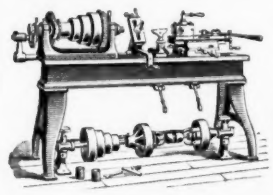

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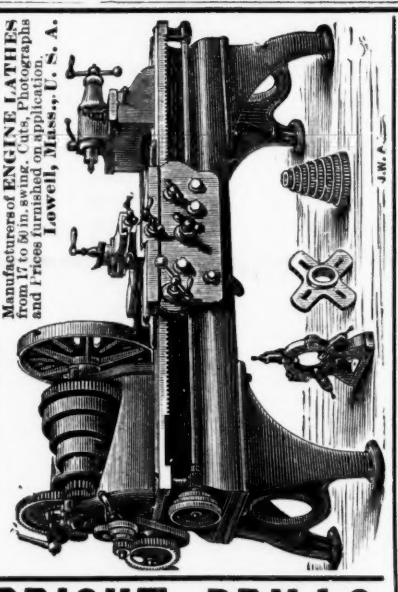

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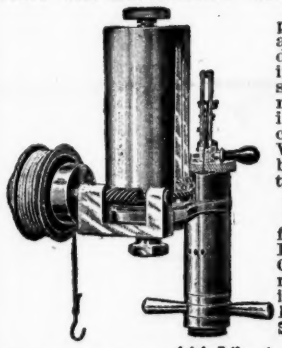

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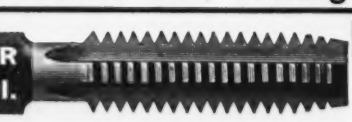

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